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MEDICAL

JURISPRUDENCE.

BY

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"Hæc est illa amica Imperantiam atque Medentium conspiratio, qua effectum est, ut aliquo veluti connubio Medicina ac Jurisprudentia inter se jungerentur." *Hebenstreit Anthropolog: Forens:*

IN THREE VOLUMES.

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Medical Jurisprudence.

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3. OF HOMICIDE GENERALLY.

To aid the administration of justice in cases of homicide is not only the most useful, but the most frequent, application of medical jurisprudence; this subject, as well for its complexity as for its importance, must be subdivided into many heads. It is first necessary that the medical practitioner should determine by examination, inspection, or dissection, whether the matter ought to be referred to the criminal tribunals, or whether the decease of the party is to be attributed to any of those natural causes, which are generally classed as "Death by the Visitation of God." In some instances this examination will take place in aid of the coroner's inquest, in others it will be preparatory to it; in both cases it is equally important that it should be minutely, faithfully, and ably conducted; for it is on the medical report that the first impressions will be founded, and the prejudices created by it in the public mind may not easily be effaced by any subsequent investigation. If, however, it be determined that the cause of death has been violent, it is then necessary to enquire to which of the classes of homicide the act is to be attributed.

"Homicide, properly so called, is either against a man's own life, or that of another." 1 *Hawk. P. C.* 102.

The first offence constitutes the crime of suicide or *felo de se.*

The second has many varieties; it may be justifiable, excusable, or wilful; and this last again, may be with, or without, malice prepense, which

constitutes the difference between manslaughter and murder; both are felony, the one with, (*a*) the other without, the benefit of clergy; to these and their numerous subdivisions we shall separately direct the attention of our reader; having first, by a general view of the physiology of death, and some practical observations on the best modes of investigation, prepared the way for a minuter examination of many of those various modes of destruction to which human life is liable.

(*a*) "But there is a particular kind of manslaughter proper to be considered here, from which the benefit of the clergy is taken away by *Ja.* 1, *c.* 8." "Where any person shall stab or thrust any person or persons that hath not then first striken the party which shall so stab or thrust, so as the person or persons so stabbed or thrust, shall thereof die within the space of six months then next following, although it cannot be proved that the same was done of malice forethought." See 1 *Hawk. P. C.* This statute was passed in consequence of the numerous murders committed by the Scots, who with their dirks stabbed before an ordinary weapon could be drawn.

For an extraordinary case on this statute, and much learning on the subject, see the trial of *William Chetwynd* for the murder of *Thomas Rickets.* 18 *How St. Tri. p.* 290.

OF REAL AND APPARENT DEATH.

If life be defined, that power by which organized beings are enabled to resist the physical and chemical operation of surrounding agents, it follows that death must be marked by the occurrence of those phenomena to which the elective attractions, no longer suspended or controlled, will necessarily give rise; hence putrefaction has been considered by many authors as the only certain sign of dissolution; unfortunately, however, this process of decomposition does not immediately display its agency by visible effects; the countenance has remained unchanged for a considerable time after death, and cases have occurred in which its colour and complexion have not only been preserved, but even heightened. This difference in the celerity with which the body putrefies did not escape the observation of the ancients, and like every other mysterious occurrence, was attributed by them to divine interposition; we accordingly find that their poets mentioned those who preserved the appearance of freshness after death, as favoured persons, who had fallen by the gentle darts of Apollo and Diana; thus Hecuba (*a*) declares that Hector, although dead for twelve days, still remains fresh, like one who had died by the hands of Apollo. On the other hand, in certain morbid states of the living frame, so feebly do the powers of life resist the operation of physical agents, that if the body cannot be said actually to enter into a state of putrefaction, it may at least assume appearances so analogous as to be mistaken for it. The test of death, therefore,

(*a*) Od. Lib. v. lin. 757.

must rather be sought for amongst those signs which indicate the quiescence, or cessation of the functions of life, than from those which manifest the decomposition of the organs by which they are performed; and here again it may be imagined that no difficulty or fallacy can occur; the total cessation of respiration, pulsation, sensation, and all motion, it might be supposed, would indicate to the least experienced the departure of life, while the general aspect of the body, its pale and livid hue, the coldness of its surface, and the stiffness of its limbs, we might conclude were signs so palpable and satisfactory as to defy the possibility of doubt. To the skilful medical practitioner we apprehend such signs must ever be unequivocal; but we are not prepared to say that a common observer may not be sometimes deceived by them; in cases of extreme debility, as in the latter stage of fever, and where the patient is confined in vitiated air, the exhaustion may be so considerable as to lend all the appearance of death; indeed that such cases have occurred we have no less a testimony than that of the philanthropic *Howard*, who, in his work on Prisons, says, "I have known instances where persons supposed to be dead of the gaol fever, and brought out for burial, on being washed with cold water, have shewn signs of life, and soon afterwards recovered." *Hippocrates*, in his Epidemics, also mentions the case of a woman who, being in appearance dead, from fever, was recovered by throwing thirty amphoræ of cold water over her body. *Diemerbroeck* (*a*) relates the case of a rustic who having appeared to die of the plague, discovered after three days no signs of respiration, but, on being carried

(*a*) Tractat. de Peste Lib. iv. Hist. 85.

to the grave, recovered and lived many years afterwards; and *Paul Zacchias* relates an analagous case which occurred at the hospital of *Santo Spirito* at Rome. At a period when the small-pox raged with such epidemic fury, and physicians so greatly aggravated its violence by their stimulating plan of cure, there can be no doubt but that many persons were condemned as dead who afterwards recovered; amongst the numerous cases that might be cited in support of this opinion, the following may be considered as well authenticated: the daughter of *Henry Laurens*, the first President of the American congress, when an infant, was laid out as dead, in the small-pox; upon which the window of the apartment, that had been carefully closed during the progress of the disease, was thrown open to ventilate the chamber, when the fresh air revived the supposed corpse, and restored her to her family; this circumstance occasioned in the father so powerful a dread of living interment, that he directed by will that his body should be burnt, and enjoined on his children the performance of this wish as a sacred duty.

We can also imagine, that women, after the exhaustion consequent on severe and protracted labours, may lie for some time in a state so like that of death, as to deceive the by-standers; a very extraordinary case of this kind is related in the *Journal des Sçavans*, Janvier 1749.

Dr. Gordon Smith, in his work on Forensic Medicine, has observed that in cases of precipitancy or confusion, as in times of public sickness, the living have not unfrequently been mingled with the dead, and that in warm climates, where speedy interment is more necessary than in temperate and cold countries, persons have even been entombed alive; we feel no

hesitation in believing that such an event may be possible; but the very case with which the author illustrates his position is sufficient to convince us that its occurrence would be highly culpable, and could only arise from the most unpardonable inattention; "I was" says *Dr. Smith*, "an eye witness of an instance in a celebrated city on the continent, where a poor woman, yet alive, was solemnly ushered to the margin of the grave in broad day, and whose interment would have deliberately taken place, but for the interposition of the by-standers;" if the casual observer was thus able to detect the signs of animation, the case is hardly one that should have been adduced to shew the difficulty of deciding between real and apparent death. Many other illustrations might be adduced, but it is not our intention to amuse the reader with a relation of those numerous *nugæ canoræ* that enliven several popular productions on the subject of *trances*, premature interments, and extraordinary resuscitations; the public have always betrayed a morbid curiosity upon the subject, and the stories of persons buried alive have ever found a ready access to our credulity, as well as to our compassion.

Amongst the different anecdotes which have been brought forward in support of the popular belief in the frequency of living interment, and in proof of the fallacy of those signs which are commonly received as the unerring indications of death, we read of numerous instances where the knife of the anatomist has proved the means of resucitating the supposed corpse; *Philippe Peu*, the celebrated French accoucheur, relates, himself, the case of a woman, upon whose supposed corpse he proceeded to perform the cæsarean section, when the first incision betrayed the awful fallacy under which he operated; the history of the unfortunate *Vesalius*, physician to

Philip II. of Spain, furnishes another instance, upon which considerable stress has been laid; upon dissecting a Spanish gentleman, it is said that on opening the thorax the heart was found palpitating; for which he was brought before the inquisition, and would probably have suffered its most severe judgment, had not the king interceded in his behalf, and obtained for him the privilege of expiating his offence by a pilgrimage to the Holy Land. (*a*)

M. Bruhier (*b*) also relates a case on the authority of *M. l'Abbé Menon*, of a young woman who was restored by the first incision of the anatomist's scalpel, and lived many years afterwards. With respect to the instance of *Vesalius* we would make this general observation, which will probably apply to most of the cases on record; that the movements which have been observed on such occasions are not to be received as demonstrations of life, they merely arise from a degree of muscular irritability which often lingers for many hours after dissolution, and which, on its apparent cessation, may be even re-excited by the application of galvanic stimuli.

(*a*) In returning, the ship was cast away on the island of Zante, when this unfortunate philosopher perished from hunger.

(*b*) *Bruhier, John*, a physician at Paris, in the middle of the seventeenth century; he was author of many works, but his principal celebrity rested on his warnings against burying persons, supposed to be dead, too early. "Dissertation sur l' Incertitude des signes de la Mort et l' abus des enterremens, et embaumemens precipites." Paris, 1742. He was at the pains of collecting histories of persons who had revived after being supposed to be dead, some of whom had been buried. Bodies ought not to be interred, he says, until putrefaction has commenced. "Memoire sur la necessité d'un Reglement general au sujet des enterremens." 1745. No one should be buried until the fourth day from their dying. "Addition aux Memoires," &c. in which he adds to the number of examples of persons who had been buried alive, or had revived after being interred. These works have passed through numerous editions, and have been translated into several other European languages.

But there is a propensity in the human mind to believe in these horrors, because between credulity and fear there is an inherent affinity and alliance; and it may be very safely asserted, that there is nothing of which we have a greater instinctive horror, (*a*) than of any force by which our voluntary exertions are totally repressed; hence it is, as *Cuvier* has remarked, that the poetic fictions best calculated to insure our sympathy, are those which represent sentient beings inclosed within immoveable bodies; the sighs of Clorinda issuing, with her blood, from the trunk of the cypress, as related in the fable of Tasso, would arrest the fury of the most savage mortal; and the sufferings which attended the confinement of Ariel, by the witch *Sycorax*, within the rift of a cloven pine, are described by Prospero as being of so pitiable a description as to move the sympathy of the very beasts of the forest.

———" She did confine thee,
By help of her more potent ministers,
And in her most unmitigable rage,
Into a cloven pine; within which rift
Imprison'd, thou didst painfully remain
A dozen years."

———" Thou best knows't
What torment I did find thee in: thy groans
Did make wolves howl, and penetrate the breasts
Of ever-angry bears; it was a torment
To lay upon the damn'd."

Tempest, Act i, *s.* 2.

(*a*) Horrible as it may appear, it was a custom in Persia, at the time that *Herodotus* wrote, of *burying alive;* and this historian was informed that *Amestris*, the wife of *Xerxes*, when she was far advanced in age, commanded fourteen Persian children of illustrious birth to be interred alive, in honour of the Deity whom they supposed to exist under the earth.—*Polyhymnia*, c. xiv.

The author of the present chapter had once an opportunity of witnessing a most striking manifestation of the popular feeling to which he has just alluded; a sailor, who had died suddenly on board a vessel in Mount's Bay, was sent on shore for interment on the same evening: this indecent haste in consigning the yet warm corpse of a human being to the grave, excited a very strong and natural feeling in those to whom the fact was communicated; in a few hours the knowledge of the circumstance became general in the town of Penzance, and imagination which, in cases that interest the feelings, is always ready to colour each feature with the hue most congenial to the fancy, soon represented the case as one of living interment, and by midnight the impression had produced so strong an effect upon the credulity of the town, that many hundred persons assembled at the house of the mayor and insisted upon the disinterment of the body; the author, in his professional capacity, was called upon to accompany the magistrates in the investigation, which was accomplished by torch light, amidst an immense concourse of people; the body was disinterred, when, it is almost needless to add, that not the slightest mark was observed that could in the least sanction the popular belief so readily adopted, and enthusiastically maintained.

Within the last few years a singular and unphilosophical work (*a*) has appeared from the pen of a learned divine, which is well calculated to cherish the public credulity upon the subject under discussion, and to excite many groundless alarms, as well as unjust expectations, respecting the possibility of latent life; the

(*a*) "A Dissertation on the *Disorder of Death*, or that state of the frame under the signs of Death, called Suspended Animation," by the Rev. *Walter Whiter*, Rector of Hardingham. Norwich, 1819. 8vo.

reverend author, it must be confessed, has furnished a practical proof of his talents in his favourite art of resuscitation, by recalling into life the numerous idle tales, and superstitious histories, that we had hoped had long since been for ever consigned to the "tombs of all the Capulets." The histories of persons having been buried alive, or recovered after apparent death, are not, however, confined to the annals of modern times; we are informed by *Diogenes Laertius* that *Empedocles* acquired great fame for restoring a woman, supposed to be dead, from a paroxysm of hysteria; and *Pliny*, in his Natural History, devotes a chapter to the subject, under the title of "*De his qui elati revixerunt*;" in which an interesting case is related of *Avicola*, whose body was brought out and placed on the funeral pile, the flames of which are said to have resuscitated the unhappy victim, but too late to allow it to be rescued from its powers; but such cases merely go to shew that the common observer may be deceived. We feel no hesitation in asserting that it is physiologically impossible for a human being to remain more than a few minutes in such a state of asphyxia, as not to betray some sign by which a medical observer can at once recognise the existence of vitality, for if the respiration be only suspended for a short interval, we may conclude that life has fled for ever; of all the acts of animal life this is by far the most essential and indispensable; *breath* and *life* are very properly considered in the

(*a*) *Plin.* Nat. Hist. Lib. vii, c. 52; see also *Valer. Maxim.* Lib. 1, c. 8. For extraordinary histories of persons roused from the tomb, see *Diemerbroeck*, Lib. ii; *Joannes Mathæus*, Quæst. Med.; *Hildanus* Cent. 2. Obs. 95, 96; *Philip Salmuth* Cent. 2, Obs. 86, 87, 95. *Maximilian Misson* relates in his voyages many curious cases of this kind. "*Nouveau* Voyage d' Italie." But the works of *Bruhier*, before mentioned, contain the greatest collection of such anecdotes.

scriptures as convertible terms, and the same synonym, as far as we know, prevails in every language. (*a*) However slow and feeble respiration may become by disease, yet it must always be perceptible, provided the naked breast and belly be exposed; for when the intercostal muscles act, the ribs are elevated, and the sternum is pushed forward; when the diaphragm acts, the abdomen swells; now this can never escape the attentive eye, and by looking at the chest and belly we shall form a safer conclusion than by the popular methods which have been usually adopted, such as the placing a vessel of water on the thorax, in order to judge by the stillness or agitation of the fluid; or holding the surface of a mirror before the mouth, which, by condensing the aqueous vapour of the breath, is supposed to denote the existence of respiration, although too feeble to be recognised in any other way.

> ————"Lend me a looking-glass;
> If that her breath will mist or stain the stone,
> Why, then she lives."
>
> *Lear*, *Act* v, *s.* iii.

For the same purpose, light down, or any flocculent substance, from the extreme facility with which it is moved, has been supposed capable of furnishing a similar indication; but the result must not be received as an unequivocal proof, and accordingly *Shakspeare*, with that knowledge and judgment which so pre-eminently distinguish him, has represented *Prince Henry* as having been thus deluded, when he

(*a*) Thus in the Greek, the most philosophically constructed language with which we are acquainted, the *alpha* and *omega*, the first and last acts of life, are conveyed in the verb αω *spiro* compounded of those letters. In Latin we also find *spiro* and *spiritus*.

carried off the crown from the pillow of *Henry* the *Fourth*—

——————" By his gates of breath
There lies a downy feather, which stirs not.
Did he suspire, that light and weightless down
Perchance must move."

With respect to the above tests it may be remarked, that an imperceptible current of air may agitate the light down, and thus simulate the effects of respiration, while an exhalation, totally unconnected with that function, may sully the surface of a mirror held before the mouth; on the other hand, we have learnt from experience that mirrors have been applied to persons in a state of mere syncope without being in the least tarnished.

Having thus considered the value of the tests of respiration, we shall proceed to appreciate those which have been considered as furnishing no less certain indications of death. The absence of the circulation, the impossibility of feeling the pulsations of the heart and arteries have been regarded as infallible means of deciding whether the individual be dead; but it is proved beyond all doubt that a person may live for several hours without its being possible to perceive the slightest movement in the parts just mentioned. It has been thought also, says *Orfila*, that an individual was dead when he was cold, and that he still lived if the warmth of the body was preserved; there is perhaps no sign of so little value; the drowned who may be recalled to life, are usually very cold; whilst in cases of apoplexy, and some other fatal diseases, a certain degree of warmth is preserved even for a long period after death. Stiffness of the body is another sign of death upon which great reli-

ance has been placed; but as it sometimes happens that it exists during life, it becomes necessary to point out the difference between the stiffness of death, and that which occurs during life, in certain diseases. For the following observations upon this subject we acknowledge ourselves indebted to the judicious treatise of *Orfila.*

1. Stiffness may be very considerable in a person who has been frozen, who is not yet dead, and who may even be recalled to life. This stiffness cannot be confounded with that which is the inevitable result of death, because it is known that the body has been exposed to the action of severe cold, and above all because it is very general; in fact, the skin, breasts, the belly, and all the organs may possess the same rigidity as the muscles, a circumstance not observable in *cadaverous* stiffness, in which the muscles alone present any degree of resistance; besides, when the skin of a frozen person is depressed, by pressing forcibly upon it with the finger, a hollow is produced which is a long time in disappearing. When the position of a frozen limb is changed, a little noise is heard, caused by the rupture of particles of ice contained in the displaced part.

2. The stiffness to which the late *M. Nysten* has given the name of *convulsive*, and which sometimes manifests itself in violent nervous diseases, may be easily distinguished from *cadaverous* stiffness; when a limb is stiff in consequence of convulsions, &c. the greatest difficulty is experienced in changing its direction, and when left, it immediately resumes its former

position; it is not the same in stiffness from death; the limb, the direction of which has been changed, does not return to its former position.

3. The stiffness which occurs in certain forms of *Syncope*, can never be confounded with *cadaverous* stiffness; for, in the former case, the stiffness takes place immediately after the commencement of the disease, and the trunk preserves a degree of warmth; whereas the *cadeverous* stiffness is not observed until some time after death, and when the heat of the body is no longer evident to the senses.

If, from a cause which it is not always possible to foresee, the individual who has been thought dead for a long time be cold and *flexible*, instead of offering a certain degree of stiffness, and at the same time if no evidence of putrefaction has as yet displayed itself, the body ought not to be buried hastily—"*Satius est adhiberi millies nimiam diligentiam, quam semel omitti necessariam.*"

The cadaverous state of the face, of which *Hippocrates* has given the following description, has been regarded as a sign of real death; the forehead wrinkled and dry, the eye sunken, the nose pointed, and bordered with a violet or black circle, the temples sunken, hollow, and retired, the ears sticking up, the lips hanging down, the cheeks sunken, the chin wrinkled and hard, the colour of the skin leaden or violet, the hairs of the nose and eye-lashes sprinkled with a kind of yellowish white dust. It must be admitted that such signs, if taken separately, are of no value, since they are sometimes observed in patients twenty-four or forty-eight hours before death; while,

on the other hand, they are often absent in cases of sudden dissolution. The softness, dimness, and above all, the flaccidity of the globe of the eye have been considered as very unequivocal in their indication. *Professor Louis* (*a*) has offered some remarks upon this subject worthy our notice; he says that, in the dead, the transparent cornea is commonly covered with a thin slimy membrane, which breaks in pieces when touched, and is easily removed by wiping the cornea; but he remarks that some appearance of it takes place in the eyes of the dying, and also allows that it may be the result of disease; so much for the value of this sign: the one which follows appears to us less exceptionable; in a few hours after death, adds this author, the eyes become soft and flabby, an effect not to be produced under any circumstances in the living body; we join in this opinion; but how often does it happen that the globe of the eye undergoes no alteration in form, until the putrefactive process has been fully established?

(*a*) Lettres sur la certitude des signes de la mort.

OF THE PHYSIOLOGICAL CAUSES, AND PHŒNOMENA OF SUDDEN DEATH.

It has been asserted by *Bichat* (*a*) that the immediate cause of death, when it takes place suddenly, must be the cessation of the functions of the heart, brain, or lungs; although it is sometimes difficult to determine which of these organs is the first to fail in its action; this may be well exemplified by the poisonous operation of Arsenic upon the animal economy, which when introduced into the circulating system will, according to the valuable experiments of *Mr. Brodie*, occasion stupor and paralysis, a feeble and intermitting contraction of the heart, and slow and laborious respiration; but it is found that in some cases, one order of symptoms will predominate, and be the first to display themselves, whilst in others, the very contrary will obtain, without perhaps our being able to assign the immediate cause of such deviations. There are, moreover, cases of sudden death, in which the principle of animation would seem to be at once annihilated in every part of the animal machine, and when every organ appears to be simultaneously affected, as in that occasioned by the agency of intense cold, and sometimes, for it is not in every instance, by that of lightning, or electricity; still, as a general proposition, the aphorism of *Bichat* must be admitted; and we shall proceed to investigate the subject of sudden death, as connected with medico-judicial inquiry, upon principles deduced from the enlightened views of this distinguished philosopher. To the able and satisfactory researches

(*a*) Recherches Physiologiques sur la Vie et la Mort.

of our English physiologist, *Mr. Brodie*, we are also greatly indebted for a correct notion of the nature and order of succession, of those events by which life is quickly extinguished; his attention was many years ago directed to one important branch of this subject,—to the investigation of that series of changes produced on living bodies by the operation of poisons, the results of which were published in the *Philosophical Transactions*, (*a*) to which we shall have frequent occasion to refer in the following pages. Since that period he has diligently pursued the subject in its more extensive ramifications, and in his lectures, delivered from the anatomical chair of the College of Surgeons during the last year, he presented a condensed and philosophical history of the phenomena of death, in general, in which he elucidated many leading points that were before obscure, established several propositions that have long been considered doubtful, and rejected a mass of popular error, which, under the sanction of authority, has continued to retard our inquiries, and to embarrass and misguide our practice. The author of the present section of this work has to acknowledge the kindness and liberality by which he is enabled to avail himself of these luminous researches, having been furnished by his friend *Mr. Brodie* with the manuscript notes from which the lectures were delivered.

The organs more immediately necessary to life are, the HEART, which conveys to every part of the body that fluid, without a constant supply and change of which, vitality must be speedily exhausted; and the LUNGS, by whose functions this essential fluid undergoes those unknown changes, from the action of the

(*a*) Phil. Trans. 1811.

atmosphere, which adapt it for the performance of the important duties to which we have alluded.

In conformity with these views, the functions of the heart, and their connection with those of the lungs and brain, very naturally present themselves as the first objects of physiological inquiry; and there is certainly no discovery in modern times more interesting in its relations, and at the same time so useful in practical application, as that which has determined the nature of the connections between the functions of respiration and the motions of the heart; and shewn why the cessation of the former should occasion the destruction of the latter. The existence of this mysterious connection constituted a subject of interest and inquiry in the more remote ages, and it will not be unprofitable to take a review of the different theories which have been proposed for its explanation. Until the celebrated experiment (*a*) of *Hook*, it was supposed that the heart's motion was maintained by the alternate contraction and dilatation of the lungs in the act of breathing; but the extraordinary philosopher above mentioned decided this point by exposing the thorax of a dog, and separating the pleura extensively from the external surface of the lungs, and then, by means of a pair of double bellows, keeping up a constant stream of air through the air cells; by this contrivance respiration was duly performed, while the lungs remained motionless, and yet it was found that the vigour of the heart's action was not in the least impaired; whereas, if the theory which *Hook* undertook to refute, had been founded in truth, the heart, under such circumstances, must necessarily have become quiescent. *Mr. Hunter* (*b*)

(*a*) Phil. Trans. 1667, vol. ii, p. 539.
(*b*) *Hunter* on the Blood, p. 54.

supposed the existence of a sympathy, or association, between the motions of the heart and lungs; and the same opinion appears to have been entertained by *Dr. Currie* (*a*); *Dr. Darwin* (*b*) deduced the existence of this immediate connection from that general law of the animal œconomy, by which motions that are frequently repeated in succession acquire the power of recurring in the same order, independently of the original exciting cause; "it is thus," says he, "that by the stimulus of the blood in the right chamber of the heart the lungs are induced to expand themselves." *Dr. Bostock* (*c*), however, has very satisfactorily opposed this hypothesis, by observing that in the fœtus the heart commences its contractions immediately upon its formation, while the lungs remain perfectly at rest; and that when the animal leaves the uterus, the motion of the lungs commences, but the periods of the contraction of the diaphragm bear no determinate ratio to those of the systole of the heart.

It was long supposed that the cessation of respiration occasioned that of the heart's motion, in consequence of the black blood not having sufficient power to stimulate its fibres; but does not the right side of the heart, which, under all circumstances, contains de-oxygenated blood, contract with a vigour equal to that of the left? It was reserved for *Bichat* to offer a true explanation of this phenomenon; he has very justly stated that, in consequence of the suspension of the respiratory function, the coronary vessels, by which the muscular structure of the heart is supplied, are compelled to carry black, instead of scar-

(*a*) Medical Reports, p. 75.
(*b*) Zoonomia, vol. 1, p. 40.
(*c*) An Essay on Respiration by *J. Bostock*, M. D.

let blood; a fact which in itself is quite adequate to explain the cause of the heart ceasing to contract; for the irritability of this, like that of every other muscle, can be alone maintained by duly oxygenized blood. But it remains to be shewn how the functions of the brain and nervous system stand related to those of the heart and lungs. Although the agency of nervous influence is necessarily involved in impenetrable obscurity, yet we shall not have much difficulty in proving, that *the brain* (*a*) *is immediately necessary to life only because the muscles of respiration owe their action to its influence. M. Lallemand* has published the history of a fœtus, in which the brain and spinal marrow were equally deficient, notwithstanding which, it even exceeded the usual size, the heart was perfect, and it was evident that the circulation had been properly performed; no sooner, however, was the monster born than it perished, because the diaphragm and other muscles of respiration were unable to per-

(*a*) A question has arisen, says *Mr. Brodie*, (*Manuscript Notes*) whether the whole of the brain is essential to the function of respiration, or whether the power of calling the respiratory muscles into action may not reside in some particular part of that organ? It has been stated by *Le Gallois* that if you expose the cavity of the cranium, and remove the upper part of the brain, the muscles of respiration continue to act as usual; if, however, the dissection be continued, as soon as that portion of the *Medulla Oblongata* is removed which corresponds to the *Corpora Olivaria*, their action is immediately suspended. The theory which such an experiment naturally establishes has received no inconsiderable support from the history of a fœtus, published by *Mr. Lawrence* in the Medico Chirurgical Transactions: in this monster the *Cerebrum* and *Cerebellum* were entirely absent, but the *Medulla Spinalis* was continued for about an inch above the *Foramen Magnum* of the occiput, so as to form an imperfect *Medulla Oblongata*, and to give origin to several nerves. Death did not take place immediately after birth, as in other instances of cerebral deficiency, but the child breathed for four days after it had been expelled from the uterus.

form their functions without the aid of nervous excitement; no air was therefore inhaled into the lungs, and in a few minutes the heart ceased to contract from the deficient supply of oxygenized blood. If the phrenic nerves of a quadruped be divided, (*a*) the motion of the diaphragm ceases, and the animal breathes by the motion of the ribs alone, panting and respiring with difficulty and distress. If the spinal marrow be divided below the origin of the phrenic nerves in the lower part of the neck, no interruption is given to the transmission of the nervous influence to the diaphragm, but the ribs now become motionless, and respiration is performed by the diaphragm only; if the spinal marrow be divided in the upper part of the neck, above the origin of the phrenic nerves, the nervous influence is neither transmitted to the diaphragm, nor to the muscles which produce the motion of the ribs, and respiration is entirely suspended; under these circumstances the heart continues to contract for some minutes, after which it ceases, as there is no supply of blood which has received the influence of the air, and, consequently, the muscular fibres of the heart lose their excitability, and the blood is no longer circulated; if, however, the lungs be artificially inflated, before the action of the heart has ceased, its motions are continued. The experiment may also be very satisfactorily varied in the following manner; apply a ligature to the carotid arteries in the neck, so as to prevent the occurrence of hemorrhage, and then decapitate the animal; if respiration be now artificially maintained, the heart will suffer no disturbance in its motions, but the circulation will be preserved for several hours in the

(*a*) *Lower*, as early as the year 1667, shewed that if the nerves which go to the diaphragm in a dog be divided, he breathes "like a broken-winded horse." *Phil. Trans.* vol. ii, p. 544.

body of the decapitated animal. In further illustration of this view of the subject, *Mr. Brodie* observes, that many reptiles which are capable of respiring by means of the skin, will survive the loss of the brain for so long a period, that the wound made by decapitation, becomes cicatrized, and death only takes place at last in consequence of inanition.—*(Manuscript Notes.)*

In farther illustration of these views, let us observe the mode in which death takes place in apoplexy, or in cases of pressure on the brain, whether occasioned by a depressed portion of bone, or by blood extravasated within the cranium. At first the patient is insensible to all external impressions, but the breathing is not affected; after an interval, however, the respiration becomes difficult and laborious, and the purple hue of the lips and cheeks, from the sub-cutaneous vessels, demonstrates that the blood is imperfectly oxygenized. The arterial action becomes more slow, in proportion only as the respiration is more difficult; and the pulse may even be distinguished at the wrist, after the breathing has altogether ceased; under such circumstances it is obvious that life might be protracted for several hours by artificial inflation of the lungs, but as no ultimate benefit could be derived from such an operation, its expediency may be fairly questioned.

Enough has been said to shew that the brain is not *immediately* necessary to the action of the heart; but *Mr. Brodie* has very justly observed that the general proposition thus established, must not lead us to the conclusion that the heart is therefore incapable of being affected by violent impressions on the nervous system; the fact is quite otherwise, for although the brain may be removed, and the circulation be never-

theless maintained by artificial respiration, yet an injury inflicted on the brain, of another kind, may be followed by those immediately fatal consequences which decapitation itself would not produce. *Dr. Wilson Philip* states that if the brain be violently crushed, the action of the heart is immediately stopped; and the fact is too notorious to be questioned, that a blow on the head is frequently succeeded by Syncope; there are but few circumstances, says *Mr. Brodie*, in the history of the animal œconomy which appears more remarkable than this fact, that *an injury of a part which is not immediately essential to the heart's action, should nevertheless, under certain circumstances, have the effect of occasioning its immediate cessation.* The late researches of *Le Gallois* may perhaps receive farther elucidation from the above proposition; this physiologist has stated that if a wire be introduced into the *Theca vertebralis*, and be moved upward and downward, so as to destroy the texture of the spinal marrow, the action of the heart presently ceases; and he from thence advances to the conclusion, not only that the spinal marrow is necessary to the heart's action, but that every part of the animal body derives its vital properties from it; from what I have observed, says *Mr. Brodie (Manuscript Notes)* in the repetition of the foregoing experiment, I should infer that the fact is correctly stated, as far as it relates to warm-blooded animals, but the conclusions are undoubtedly premature; and the history of the fœtus, as related by *Lallemand*, in which, notwithstanding the absence of the brain and spinal marrow, the child was even larger than usual, the heart perfect, and it was manifest that the circution had been duly performed, is in direct opposition to such a theory. We must here agree with

Mr. Brodie, that such phenomena are quite incompatible with the doctrine in which the spinal marrow is supposed to be directly necessary to the existence of vitality in the system generally, and to the action of the heart in particular; and that we must therefore look for some other explanation of the effects which are produced by the destruction of the spinal marrow in warm-blooded quadrupeds.—May they not be explained by supposing them to be the effect of the shock which must necessarily attend the removal of the spinal marrow, which can never be effected with the facility that attends decapitation?

We have deemed it necessary to offer these few remarks upon the relations which subsist between the functions of the heart, lungs, and brain, in as much as the propositions which have been thus established respecting them, can alone lead to a correct pathology of those diseases, by which life is suddenly extinguished, or suggest a rational and effectual plan of treatment, in cases of supended animation.

SYNCOPE:

In which the pulsations of the heart cease, before the action of the respiratory organs.

The heart may cease to beat either from organic lesions in its own structure, or in that of its vessels; or from being sympathetically affected by injuries in other parts (*a*); or from the operation of certain poisons; or from a shock of the general nervous system, as experienced in paroxysms of certain passions.

In ordinary fainting it is evident that some slight and feeble motions of the heart still continue, although insufficient to produce a sensible pulsation in the more distant arteries; and where this has continued for an unusual period, and the respiration has been so obscure as to escape common observation, the phenomenon has been eagerly seized by the admirers of the marvellous, and credulity has attached to its history, under the name of *Trance*, (*b*) circumstances of extravagance and mystery, to which it can hardly be necessary to allude on the present occasion. But the motions of the heart may have ceased

(*a*) While this work was in progress we have read an account of a person who, being in a state of debility, died suddenly from the shock of a shower bath at Brighton. In this case Syncope was probably occasioned in the same manner as by a blow on the head.

(*b*) *Trance.* Although this term is extremely familiar, it does not appear that any precise meaning is attached to it; the popular notion is that the body may for a time be abandoned by the soul, and remain for a certain period in a deep sleep, during which the exercise of the vital functions is so obscure, that the individual is reduced to a state of close simulation of death.

altogether, and in such cases it become a question, no less interesting to the practical physician than to the physiologist, whether they can ever be restored, and if so, we have to inquire under what limitation, as to time; under what circumstances; and by what means? The views which have been already offered respecting the pathology of Syncope will afford us considerable assistance in the solution of a problem, so intimately connected with inquiries of forensic importance. It would appear that where the heart has ceased to pulsate, *in consequence of the cessation of respiration, it can never again be set in motion;* but that where it has stopped from other causes, as from the operation of certain poisons, its muscular irritability not having been exhausted, its action may be occasionally revived. Where Syncope arises from hemorrhage, we shall find, on dissection, that the heart and its great vessels are either empty, or contain only a small quantity of blood in their cavities; but where Syncope arises from other causes, the heart is seen distended to an unusual magnitude, and the blood in the left auricle and ventricle is generally of a more or less florid colour, and has not the hue of venous blood; a circumstance which depends upon the pulsation of the heart ceasing before the function of respiration, and which is the very reverse of what happens in death from suffocation, as we shall hereafter explain.

Violent passions of the mind very commonly produce syncope, which has in some instances terminated in death; we are however inclined to believe that in fatal cases of this nature the persons must have laboured under some organic affection of the heart, or its vessels; *Philip V.* died suddenly on being told

that the Spaniards had been defeated, and on opening the body, his heart was found ruptured.

Dr. Tissot relates also the case of the father of a numerous family, who having lost his wife whom he tenderly loved, was suddenly seized with laborious respiration, and died at the end of two days; when the lungs were found gorged with blood, and the heart ruptured. Now in both these cases, it is probable that the muscular structure of the heart had been softened by previous disease. (*a*) So in the case

(*a*) A great question has arisen upon this subject, whether rupture of the heart ever takes place in the sound state of that organ? And it has been answered by several pathologists in the affirmative. Fischer's case from the JOURNAL DER PRACTISCHEN HEILKUNDE, may be seen in the MEDICAL REPOSITORY, Vol. 11, p. 427, and Vol. 12, p. 164. HARVEY found in a male subject a rupture in the aortic ventricle, capable of admitting a finger, and remarked that the parietes of the cavity possessed their natural strength and thickness (Exercitat III. De Circulo Sanguinis, T. p. 1. 281.) BOHN also gives a case of a man who had died suddenly, when a fissure was discovered in the *Ostium Aortæ*. PORTAL has informed us, that in a rupture of the basis of the heart, which he examined, the structure of the organ was as firm and compact as in the natural state, and that in another case the parietes of the heart displayed their natural solidity. (Memoires de l'Academie des Sciences, a Paris, 1784, p. 51.) SOEMERING considers it as having been very correctly remarked by Portal, that the Aortic ventricle commonly bursts without any previous weakening of the substance of the heart. (See Soemering's German Translation of Baillie's Morbid Anatomy, with Additions.) DR. WHYTT has likewise seen the heart burst from protracted grief, and therefore does not regard the term, "BROKEN HEART," in the light of a mere metaphor. On the contrary, BOERHAAVE has recorded two cases, and believes that the rupture was occasioned by the morbid accumulation of fat; KREYSIG suspects that in most of these cases of ruptured heart an insidious inflammation had been established, and he considers that the quantity of adipose substance in which ruptured hearts are so commonly found enveloped, furnishes an evidence of this inflammatory state (Sopra i Malattée del cuore.) We are decidedly of opinion that such ruptures take place in consequence of a morbid state of the heart capable of diminishing the cohesive power of its fibres. See a Treatise on the Diseases of the Chest by *R. T. H. Laennec, M. D.* translated by *J. Forbes, M. D.* London, 1821.

of *Mr. John Hunter*, whose life was suddenly extinguished by mental emotion, the valves of the heart had been long in a state of disease, and so well aware was he of the danger to which he was constantly exposed, that he had for some time previous to his death, been in the habit of retiring from all those situations, in which his passions were likely to be excited. It is said that the instances of death from sudden joy are more numerous than those from grief, probably because the effect of this latter passion is rather to retard than to accelerate the circulation; *Sophocles*, being desirous of proving that at an advanced age he was in full possession of his intellectual powers, composed a tragedy, was crowned, and died through joy; the same fate befel *Philippides* the comic writer; thus too the Lacedemonian *Chilon* expired in the embrace of his son who had borne away the prize at the Olympic games; and we read of Roman women who died in the same manner, upon seeing their sons return from the battles of Thrasymene and Cannæ. On the other hand, we might adduce much classical authority to shew that death has frequently been the sudden effect of grief.

Montaigne relates the case of a German, who after having performed great feats of valour, was killed at the seige of Osen; one of the general officers having desired to see the corpse of so gallant a man, was conducted to the body, when he instantly recognised the features of his own son, and died on the spot. The record of our own times will furnish us with an instance in which an actor of celebrity suddenly expired upon repeating a passage that contained a fancied allusion to the domestic affliction under which he was suffering.

Dr. Ozanam, (*a*) in illustration of the influence of pain and terror in producing sudden extinction of life, relates the case of a middle aged criminal, who having throughout evinced extreme weakness and depression, expired in his way to the scaffold, and was stiff before he arrived at the place of execution, which was about seven miles distant.

In such cases of sudden death, from the operation of violent mental emotions, we apprehend that dissection will frequently demonstrate the existence of previous disease in some of the organs immediately essential to life; and we shall hereafter have occasion to refer to the influence of the passions in hastening the fatal termination of a chronic disease; on the present occasion we introduce the following extremely interesting case, in confirmation of the position we are endeavouring to maintain; the case was originally published in the *Transactions of the Physico-Medical Society of New York, by Dr. Valentine Mott;* it afterwards appeared in the *Journal Universel des Sciences Medicales, Avril*, 1819; and lately it has found its way into the *Medical Repository* of this country. A robust and plethoric female, aged 22, long addicted to dissolute and intemperate habits, had complained for some time of slight and apparently rheumatic pains; but within a day or two of the fatal event, she had been deserted by a man to whom she was engaged in marriage; in consequence of which her mind became very deeply affected; after having supped on the preceding night, she retired to rest as usual, and in the morning was found dead in bed; she lay in a bent position on the left side; and was hence supposed at first to be in a profound sleep;

(*a*) Recueil Periodique de la Societé de Medicine de Paris. T. LXI. p. 87

neither the countenance nor the limbs were in the least distorted. On dissection the pericardium was found to contain ten ounces of coagulated blood, and two of serum; the heart on all sides being covered by it, was of ordinary volume, but much loaded with fat; at the summit of the aortic ventricle was discovered the breach from which the effused blood had issued; the parietes of the ventricle around the rupture were much thicker than in the natural state, and on close examination a very sensible fluctuation was distinguished, to the extent of an inch on one side of it, from which flocculi of a cheese-like substance were discharged on pressure; the pericardium also presented traces of inflammation.

We have here then a case in which a morbid change in the structure of the heart had existed for a considerable period, and which was suddenly brought to a fatal termination by an affection of the mind.

Before we quit the consideration of *Syncope*, we have to notice a fatal variety of that disease, which well deserves the attentive consideration of the forensic Physician, whose highest duty, let it be remembered, is the investigation of sudden death. It is described by *Mr. Chevalier* (*a*) under the term *Asphyxia Idiopathica*, in which the patient suddenly faints and dies; the essential circumstances of the disease evidently denote, says *Mr. Chevalier*, a sudden loss of power in the extreme vessels to propel the blood; in consequence of which the heart after having contracted, so as to empty itself, and then di-

(*a*) Medico-Chirurg. Trans. vol. 1, p. 157. Analogous cases to those related by *Mr. Chevalier* will be found in *Bonetus* Sepulchr. Anat. vol. 1, p. 383; and *Morgagni* Epist. 48, Art. 44; see also a communication by *Dr. Ozanam* in the Recueil Periodique de la Societé de Medicine de Paris, tom. 61, p. 87.

lated again, continues relaxed for want of the return of its accustomed stimulus, and dies in that dilated state. On dissection all the cavities of the heart are found completely empty, and the viscus itself in a state of extreme flaccidity.

SUFFOCATION.

SUFFOCATION may be defined, the destruction of life by the suspension of the function of respiration, occasioned by external violence. Unless we add "*by external violence*" we shall perceive that the definition would be far too comprehensive; and the term *Suffocation* would be made to embrace a much wider range of subjects than its popular acceptation would allow. If the physiological views be correct which we have adopted and explained in the foregoing section, "On the causes and phenomena of sudden death," we should be compelled, without such a protecting adjunct, to include under the history of Suffocation, not only the phenomena of Drowning, Strangling, Hanging, Smothering, and noxious inhalation, but even those of Apoplexy, fatal Intoxication, and various diseases of the brain and spinal marrow, together with the effects of a great proportion of Poisons; for by such agents death is undoubtedly occasioned through the failure of the respiratory functions.

In Death from Suffocation the heart continues to pulsate for several minutes after the breathing has entirely ceased, in consequence of which the blood which passes through the pulmonary vessels no longer receives the influence of oxygen, and therefore *black* blood circulates; the brain, it would appear, soon feels the want of the florid arterial stream, by which alone its energies can be maintained. *Bichat* has shewn that when dark coloured blood is injected into the vessels of the brain, by means of a syringe con-

nected with the carotid artery, the functions of the brain become immediately disturbed, and, in a short time, entirely cease; the effect is precisely similar, whether the dark coloured blood be transmitted to the brain by the syringe of the experimentalist, or by the heart itself. It is not until after the full effects of the suspended respiration are thus produced on the brain, that the motions of the heart become enfeebled, and that the ventricles contract less powerfully, and at longer intervals; at length, the action of the heart is altogether arrested, and if the thorax be examined at the instant that the circulation has ceased, nothing is observed, except a slight tremulous motion of the auricles; the cavities of the left side are much contracted, and contain only a small quantity of blood, while the right auricle and ventricle, and the large vessels communicating with them, are distended to an unusual size. This state of the heart, it will be observed, is very different from that which we have described as constantly occurring after *Syncope*. In the contemplation of these phœnomena, a question very naturally suggests itself in regard to the probable interval which elapses between the cessation of respiration, and the consequent failure of the heart's action; in other words, it may be asked, how long can the heart support its contractions without the aid of respiration? It would appear that this interval not only varies in duration in different animals, but even in the same animal under different circumstances, such as that of age, (*a*) capacity of the

(*a*) A young animal may not so soon perish as an older one; and a strong and healthy individual may survive during a longer period than a creature that is in a state of debility. By filling the lungs with air a person may also be enabled to dispense with the act of respiration for a longer period; *Mr. Kite* made a very deep inspiration of 300 cubic

thorax, quantity of air in the lungs, state of the stomach, and general vigour of the animal; but in man, under the most favourable circumstances, it is extremely doubtful whether the heart ever continues to pulsate for so long a period as five minutes (*a*) after the lungs have ceased to perform their office; and it is very questionable whether, in most instances, the interval is not considerably shorter than this.

inches, and was thus enabled to retain this quantity for 72 seconds, without a fresh inspiration; and divers in the pearl fisheries, inspire deeply before they descend. It has been, moreover, established by numerous experiments that the demand for oxygen in the lungs is materially influenced by the nature of the ingesta received into the stomach; *Mr. Spalding*, the celebrated diver, observed, that whenever he used a diet of animal food, or drank spirituous liquors, he consumed in a much shorter time the oxygen of the atmospheric air in his diving-bell; and therefore he had learned from experience to confine himself to a vegetable diet, and water, when following his avocation. And the priest, or conjurer (*Pillal Karras*, in the Malabar language) who attends the divers in the pearl fisheries of the east, enjoins, as a religious duty, an abstinence from all food, before he plunges into the ocean.

Muscular exertions, as in the act of struggling, will without doubt contribute to the expenditure of oxygen, and increase the demand for it, and therefore in its absence such movement must accelerate death by suffocation; this physiological fact will be hereafter more fully elucidated.

(*a*) We anticipate the objections that will be urged against the truth of this assertion. It will be asked how it can be reconciled with the accounts of persons who have recovered after an asphyxia of a much longer duration? It may be inquired how the statement can be reconciled with the ordinary histories of divers, who have become so expert in the art which they profess, as to be capable of remaining beneath the water for twenty minutes, or even for a longer period: we are bound to consider such statements as no better than extravagant fables; not more authentic, says *Mr. Brodie* (Manuscript Notes), but certainly less poetical and elegant, than those of the nymphs and mermaids, whose ordinary residence is in grottos beneath the waves of the sea; or than those Arabian fictions which have amused and astonished our youthful imaginations with the description of the Princes who govern the submarine nations, and pass their lives in palaces of crystal at the bottom of the ocean—but of this we shall speak more fully hereafter.

BY DROWNING.

It was formerly believed that *Asphyxia (a)* from *drowning*, always depended upon the lungs and intestinal canal being filled with water; *(b)* whereas it is hardly necessary to observe that it alone depends upon the blood, in consequence of the suspension of breathing, ceasing to possess the qualities which are essential to the preservation of life. *M. Gauteron* immersed a dog for more than a quarter of an hour, without inflicting the least injury, having previously inserted a long tube in the trachea, which was kept elevated during the experiment above the surface of the water.

If a small animal be immersed in water, contained in a transparent glass vessel, the phenomena of drowning are readily discernible; there is first a deep expiration, by which bubbles of air are expelled from the lungs; there is then an effort to inspire, but the effort is ineffectual; there being no air which can be received into the lungs, and a spasm of the muscles of the glottis seems to forbid the admission of any considerable quantity of water into the trachea. The attempts to breathe are repeated several times, and at each attempt at expiration a small proportion of air is expelled from the mouth and nostrils, until the

(*a*) Although the term ASPHYXIA merely signifies the absence of the pulse, yet the name is erroneously applied to every apparent loss of vitality.

(*b*) DE HAEN thought that death was produced in drowning by the water flowing into the lungs, and thus stopping the passage of the blood in the arteries. This belief gave origin to the very erroneous and mischievous practice, which still continues amongst the more ignorant, of suspending drowned persons by the heels, or of rolling them over barrels.

air-cells of the lungs are almost emptied; (a) then the animal becomes insensible; and convulsive action of the voluntary muscles mark the instant when the brain begins to suffer from the influx of the dark coloured venous blood. After the cessation of these convulsive actions, the animal becomes motionless, and gives no sign of life; but if the hand be applied to the thorax, the actions of the heart, gradually becoming fainter and fainter, indicate that some remains of vitality still linger in the system. Before the circulation of the blood altogether ceases, the muscles of respiration once more resume their actions, and ineffectual efforts are made to breathe. It is a remarkable circumstance that the diaphragm continues to exert itself nearly as long as the heart itself, and that the interval between the cessation of the motions of the diaphragm and that of the motions of the heart,

(a) *Mr. Coleman* examined the lungs of a cat which had been drowned, by placing a ligature on the trachea, removing the lungs from the thorax, and then making an opening in the trachea under water, so as to collect the air which issued from the orifice; the whole quantity of air thus obtained, amounted only to half a drachm; yet the same lungs when inflated, required as much as two ounces of air, by measure, for their distention. Nor would the presence of water appear to be immediately fatal, when introduced into the lungs; Dr. *Goodwyn* poured two ounces of water into the lungs of a cat, through an opening made between the cartilages of the trachea; the animal had an immediate difficulty of breathing, and a feeble pulse, but lived several hours afterwards without much apparent inconvenience; it was at length strangled, and the water was found in the lungs. From which it would appear, that the admission of a certain portion of water, does not tend to hasten death. The author of this note was present at an experiment made by Mr. *Brodie*, in which he drowned a guinea pig, whose trachea had been previously perforated; so that in this case, no spasm of the glottis could arrest the ingress of the water into the pulmonary air cells; but this produced no modification of the usual symptoms; nor did it prevent the resuscitation of the animal, which was afterwards effected by the appropriate methods.

which is so short in animals that die by strangulation, is still shorter in those who perish by drowning. *(a)* These phenomena follow each other in rapid succession, and the whole scene is closed, and the living animal is converted into a lifeless corpse, incapable of recovery, in the brief space of a few moments. *(Brodie's Manuscript Notes).* If however the animal be taken out of the water before the total extinction of life, and the diaphragm contract afterwards, so as to draw air into the lungs before the action of the heart has ceased, the circulation is maintained, and the animal continues to respire; he will thus have escaped immediate death from suffocation; but his life still remains in jeopardy, for there is asecond period of danger, and one at which death may take place, when we are the least prepared to expect it; for the dark coloured blood which has been transmitted through the circulatory system, during the suspension of respiration, would seem to act like a narcotic poison upon the brain; no sooner therefore does it enter that organ, but deleterious effects are produced, the animal at first falls into a state of stupor, the pupils of the eyes become dilated, the respiration laborious, the muscles of the body convulsed, and the animal dies, *poisoned by its own blood.*

The body of a person who has died from drowning exhibits a physiognomy which it is important to notice. The whole surface is distinguished by a remarkable coldness and pallor; the eyes are half open, and their pupils considerably dilated; the tongue is push-

(*a*) An animal also dies sooner by drowning, than by simple strangulation; Mr. *Brodie* considers that the abstraction of heat in the former case is quite sufficient to account for this difference.

ed forward to the internal edges of the lips, and sometimes wounded; and the mouth and nostrils are covered with foam. At other times, instead of a pallid visage, we have one that is swelled, and bloated with livid blood.

Upon dissection we shall perceive the vessels of the brain more or less gorged with blood; *(a)* in the trachea a watery and bloody froth will be found; the lungs will appear expanded, full of frothy mucus, and, generally, livid; the right cavities of the heart gorged with blood, the left nearly empty; and it has been sometimes noticed that the blood remains fluid *(b)*, and follows after every incision by the scalpel. The stomach will generally be found to contain some water. *Hebenstreit* also states, that since in the act of drowning the person dies on an inspiration, the diaphragm is necessarily found convex, or bent towards the abdomen; this statement however is erroneous.

Upon these appearances we have a few observations to offer, especially as they have given origin to some important questions; and first, with respect to *the presence of water in the stomach and lungs*, than which few indications, connected with the subject of drowning, have given occasion to greater controversy. *(c)* For since it hath been observed that water is rarely found in the stomach or lungs of a person who has been submerged after death, it was inferred that the presence of that fluid in these organs necessarily proved that the individual must have been

(*a*) *Foderè*, 90.

(*b*) *Walther*, de Morbis Peritonai, et Apoplexia. 3 *Foderè*, p. 106.

(*c*) See the Reports of the Edinburgh colleges, in the case of Sir *James Standsfield*, as printed in the Appendix, p. 225, also Extracts from Medical Evidence in the case of *Spencer Cowper*, Esq. for the murder of *Sarah Stout*, ibid. p. 230. 3 *Foderè*, p. 93. 100. 108. The case of *Servin*, ib. 125. of *Paulet*, ib. 126.

plunged into the water during life. As a general proposition this may be admitted as correct, although it is liable to certain exceptions with which the medical jurist ought to be acquainted; we may, for instance, suppose a case, in which the submerged person may be so plunged at once under water, as to have been suffocated without his previously coming to the surface, and when *asphyxia* has taken place, the powers of deglutition, on which the presence of water in the stomach wholly depends, are at an end; or we may suppose that the party in question faints from terror; a remarkable instance of this kind is quoted by *Foderè*, *(a)* from *Plater*, of a young woman, who having been condemned to be drowned for infanticide, fainted at the moment she was plunged in the water, and having remained for a quarter of an hour under its surface, recovered after being drawn out. *(b)*

With respect to the presence of water in the bronchiæ and lungs, we may observe that, in the violent struggles of a drowning man, a certain portion of water generally passes the epiglottis; and being immediately mixed with the air and mucus of the trachea, constitutes that frothy mucus, which we have described as being so highly characteristic of this species of violent death; although we are not to conclude with *Larrey*, that it is the immediate cause of dissolution in such cases. The quantity of water, however, thus forced into the pulmonary structure, is extremely small, for its entrance is powerfully opposed by a spasm of the muscles of the glottis; *(c)*

(*a*) Medicine Légale, vol. iii. p. 85.

(*b*) During such a state of the body there would be but a feeble call for oxygen; it is muscular action which so rapidly expends this important principle.

(*c*) In an experiment with a drowned cat, Mr. *Brodie* found less than a drachm of water in the bronchial vessels. Other physiologists have ascertained the same fact by drowning animals in different coloured fluids.

were it to occur in any considerable quantity, and to appear in its fluid state, instead of that of froth, the influence would clearly be, that *it had passed in after death.*

Although the presence of this frothy matter must be considered as a strong presumptive proof that the person found in the water had perished by drowning, the converse of this proposition is by no means established by the absence of such an indication.

The buoyancy of the human body is another point in the history of Drowning, which has occasioned much discussion; and in solving the problem, so highly important in its forensic relations, *whether a body found in the water, had been drowned, or thrown in after death*, it has been considered by some physiologists as capable of affording a certain degree of presumptive evidence, although we are inclined to attach but little or no importance to such an indication. The specific gravity of the human body, under ordinary circumstances, is very little greater than that of fresh water, so small indeed is the difference that, when the lungs are inflated, a man will float (*a*) with little or no effort, if he have sufficient self possession, and does not attempt to raise too great a portion of his body out of the sustaining fluid; (*b*) but, when the air of the lungs is expelled, and probably, at the same time, a certain quantity of water is taken into the stomach, (*c*) the body becomes specifically heavier, and the victim sinks. It may be assumed as a gene-

(*a*) See a very curious paper upon this subject by Mr. *Robertson*, in the Philosophical Transactions, 1757, vol. l. p. 30; from which it appears that the author made ten experiments, in which, with the exception of one person, he found all the men *specifically lighter* than water, and hence he concludes that drowning might be avoided, if the person who falls into the water were not deprived of his presence of mind.

(*b*) *Franklin's* Art of Swimming.

(*c*) Vide *Valent. Pand Med. Leg.* 297. "De reperto sub aqua Cadavere," and 299 "De Submersorum morte sine pota aquæ."

ral rule, that no newly drowned body floats, although many facts have been adduced in support of a contrary opinion; the naval custom of loading the dead bodies with weights, before they are consigned to a watery grave, is not for the purpose of sinking the corpse, but for preventing its rising after the process of putrefaction has commenced. The period during which a body will remain at the bottom cannot be very accurately determined, as the change does not take place until a sufficient quanity of air be generated to buoy it again to the surface; in the melancholy instance of the loss of the Royal George, the dead bodies were observed ascending to the surface of the sea, on or about the fifth day. The general position of a body which has thus risen, provided there be no external or adventitious circumstances to change it, is such, that it floats nearly immersed, the face, arms, and legs hanging downwards, and the loins being uppermost; this is the form which the body must mechanically and hydrostatically assume, if the sustaining power of generated air be, as it generally will, in the cavity of the abdomen, where putrefaction is more likely to commence; for the head and limbs are generally (*a*) specifically heavier than water, while the trunk, especially if inflated with air, is somewhat lighter.

It has been said that a position, different from that which we have just described, will take place where the person has been strangled, and the body then thrown into the water; for in this latter case, it is contended, that the lungs will be distended with air, and that consequently, the sustaining power must be in the thorax; in support of this opinion the story of

(*a*) We say, "*generally*" because the comparative size of bone, on the one hand, or the quantity of fat on the other, will make a very considerable difference in the specific gravity of different parts of the human body.

the appearance of *Caraccioli* (*a*), Admiral of the Neapolitan navy, has been ingeniously adduced; this unfortunate man was hanged in pursuance of the sentence of a court martial, and his body was committed to the deep in the usual manner; thirteen days after which, while the King of Sicily was walking on the deck of Lord *Nelson's* ship, he suddenly exclaimed with a yell of horror—"*Vien! Viene!*"—The Admiral's corpse, breast high, was seen floating towards the ship; the shot that had been attached to the feet for the purpose of sinking it, not being sufficiently heavy. This may perhaps be explained by supposing that the corpse was stiff before it was immersed, in which case, the centre of gravity being exceedingly low on account of the shot tied to the feet, he must have floated upright, wherever the buoyant power from generated air might be situated. At all events, we feel no hesitation in at once rejecting the proposition, for the support of which it has been brought forward; the fact is that, in relation to gaseous contents, the lungs are the same in strangled, as in drowned persons; for in both cases a quantity of air is forcibly expelled from them before dissolution.

2. BY HANGING:

The suspension of a person by means of a cord, or some other ligature, round the neck, by which death is produced by closing the trachea, and preventing respiration.

Although we are in this case bound to admit that the immediate cause of death is suffocation, yet we cannot deny that other injuries are often produced by hanging, such as

1. *Pressure on the vessels.*
2. *Pressure on the nerves.*

(*a*) See *Southey's* Life of Nelson; and the New Monthly Magazine for January, 1821.

3. *Fracture of the spine, and dislocation of the odontoid process.*

1. *Pressure on the Vessels.*—The red and livid hue of the face of persons killed by hanging, very naturally induced a belief that *Apoplexy* (*a*) was the immediate cause of death; while it is evident that the pressure on the jugular veins must necessarily so prevent the return of blood to the heart, as to produce an accumulation in the vessels of the brain: *Dr. Hooper* has a preparation of the brain of an executed criminal, in which blood is seen extravasated among the membranes; and various other cases have occurred, where dissection has clearly demonstrated the existence of those vascular congestions and sanguineous effusions, upon which apoplexy is supposed to depend; but this merely goes to prove that apoplexy occasionally takes place from hanging; it does not establish the fact of its being the common cause of death on such occasions.(*b*) *Gregory* made the following experiment to shew that it is to the interception of air that death is to be attributed; after having opened the trachea of a dog he passed a slip knot round the neck, above the wound; the animal, though hanged, continued to live and respire, the air was alternately admitted and easily expelled through the small opening; but as soon as the constriction was made below the orifice, the animal perished. *Mr. Brodie* hanged a dog, and as soon as it became insensible, the trachea was opened below the ligature, upon which he breathed, and his sensibility returned.

(*a*) This was the opinion of *Boerhaave* and *Morgagni*. *M. Portal* also coincides with them, and observes that the examination of the bodies of executed criminals formerly carried to him at the *Jardin des Plantes* for his lectures, has confirmed him in this idea.

(*b*) See 3 *Foderè*, 130.

2. *Pressure on the Nerves of the Neck.* Although the pressure of a ligature on the nerves of the neck cannot be considered as the immediate cause of death in hanging, yet *Mr. Brodie* has very justly observed, that if the animal recovers of the direct consequence of the strangulation, he may probably suffer from the effects of the ligature upon the nerves afterwards. *Mr. Brodie* passed a ligature under the trachea of a Guinea pig, and tied it tight on the back of the neck with a knot; the animal was uneasy, but nevertheless breathed and moved about; at the end of fifteen minutes the ligature was removed; on the following morning, however, the animal was found dead. On dissection no preternatural appearances were discovered in the brain, but the lungs were dark and turgid with blood, and presented an appearance similar to that which is observed after the division of the nerves of the eighth pair; I do not, observes *Mr. Brodie (Manuscript Notes)* positively conclude from this experiment that the animal died from an injury inflicted upon the nerves of the eighth pair, but I think that such a conclusion is highly probable; and it becomes an object of inquiry whether a patient having recovered from hanging, may not, in some instances, die afterwards from the injury of the *par vagum.*

3. *Fracture of the Spine, and Dislocation of the Neck.* The death of a hanged person may occasionally take place by the luxation of the cervical vertebræ, and the consequent injury of the spinal marrow; this effect will be more likely to happen in heavy persons, and where the culprit suffers on a drop that precipitates him from a considerable height. It is said that *Louis* discovered that of the two executioners in Paris and Lyons, one dispatched the criminal condemned to be hanged by luxating the

head on the neck, whilst those who perished by the hands of the other were completely strangled.

An animal, when first suspended, is observed to make repeated but ineffectual attempts to inspire; violent convulsions of the whole body then ensue, but which are not to be considered as the indications of suffering, for they arise in consequence of the dark coloured blood having reached the brain and spinal marrow; and the animal at this period is necessarily insensible; hanging does not occasion a painful death.(*a*)

The lips, nose, and all those parts in which the hue of the blood can be observed, exhibit a dark colour; the countenance is distorted, the eyes protruded, and frequently suffused with blood, the tongue is also forced out of the mouth, and sometimes wounded, although it has been observed that this phenomenon will entirely depend upon the position of the rope, for that when it presses above the thyroid gland the tongue will be pushed back, in consequence of a compression upon the *os hyoides*, whereas if the pressure be applied under the *cricoid* cartilage it will have the effect of thrusting out the tongue. Blood is sometimes discharged from the ears. It is not unusual for the sufferer to void his urine, fæces, and even semen, in *articulo mortis*. The fingers are usually bent, the nails blue, and the hands nearly closed; and the whole physiognomy exhibits a highly characteristic appearance.

"But see, his face is black and full of blood,
His eye-balls further out than when he lived,
Staring full ghastly, like a strangled man,
His hair uprear'd, his nostrils stretch'd with struggling,
His hands abroad display'd, as one that grasp'd
And tugg'd for life, and was by strength subdu'd."

Henry VI, *Part* ii, *Act* iii, *s.* 2.

(*a*) See several cases cited by *Fodere*, T. 3. p. 134.

The dissection of a hanged person exhibits the same phenomena as those described under the history of drowning, with the exception of the absence of water in the *bronchiæ*. With respect to the quantity of air found in the lungs, much discrepancy of opinion has existed. *Dr. Goodwyn*, in his experiments on respiration, found that the lungs of a person who had died from hanging, contained double the quantity of gaseous contents of those who had died a natural death. This result, however, is certainly not correct; for there is always, as we have already stated, a very forcible expulsion of air from the lungs in the act of strangulation, and they are accordingly found almost empty after death. *Mr. Coleman* hanged an animal, and then secured the *trachea* by a ligature, and removed the lungs; when, upon receiving their gaseous contents in the hydropneumatic apparatus, he found their quantity was very far less than that which would have been collected under other circumstances.

3. BY MANUAL STRAGULATION.

Whether strangulation be induced by the suspension of the body by the neck, or by a ligature drawn tight, or by any other pressure upon the trachea, the physiological phenomena of death are the same; where, however, the person has died from manual strangulation, the marks about the neck will probably be more evident, and the discolouration will correspond with the marks of the fingers and nails; and we may also expect to find traces of violence upon the chest, for since the weight of the body is not obtained in such a case, additional force becomes necessary to

consummate the fatal act. On opening the bodies of those who have been taken off by manual strangulation, *Dr. Smith* thinks that the usual appearances of this kind of death may not seem so conclusive as in other cases: an opinion in which we feel inclined to coincide; for in consequence of the greater resistance of the sufferer, the functions of respiration and circulation may continue in some measure for a longer period than in drowning or hanging, which must be considered as more summary processes of suffocation. In the case of a woman who had been thus strangled by two men, *Littre* found the tympanum of the left ear lacerated, whence flowed about an ounce of blood; the vessels of the brain were unusually turgid, red blood was extravasated in the ventricles, as well as at the base of the cranium; the lungs were distended and their membrane vascular; not more, however, than an ounce of blood was found in the right ventricle of the heart, and it was fluid and frothy, like that in the lungs; this circumstance deserves particular notice, and can only be explained by supposing that the respiration and circulation were not at once arrested, but that the unhappy sufferer was enabled to inhale air, at intervals, during the protracted struggle (*a*); and yet in certain cases, death may be very easily occasioned by manual strangulation, of which the murder of *Dr. Clench*, in the year 1692, may be adduced as an example; this gentleman was strangled in a hackney coach by two men, while driving about the streets of the city, without the coachman having the slightest knowledge of the transaction, until he afterwards found him quite dead, kneeling down with his head on the seat, and a hand-

(*a*) Memoires de l' Academie Royale, &c. 1704.

kerchief bound about his neck, in which was a piece of coal, placed just over the windpipe. (*b*)

4. BY SMOTHERING.

In this act the transit of the air into the lungs is prevented by forcibly closing the nostrils and mouth. It is very obvious that such a mode of destruction can very rarely occur in an adult; for a comparatively feeble resistance will be sufficient to overcome the assailant in such an attempt. It may, however, occur accidentally; it is not difficult to imagine that a person, in a fit of intoxication, may be unable to extricate himself from a position in which he might fall, and in which respiration could not be performed. In children this mode of suffocation is less rare, and it may be either the result of design or accident, to which we shall have occasion to refer, when treating the subject of Infanticide.

5. BY THE INHALATION OF AIR DEPRIVED OF OXYGEN.

There are many gases, the inspiration of which occasions death; some of these act simply by excluding oxygen, while others exert an absolutely deleterious action in consequence of the specific powers which they possess. It is exclusively to the first species that our attention is at present to be directed; the latter will constitute matter for future consideration, under the title of *Aërial Poisons.*

(*b*) State Trials, vol. xii.

It is a fact too well established to require any discussion, that *oxygen* is the only principle which is capable of producing the necessary changes in the blood, during its transmission through the lungs; and that, accordingly, whenever atmospheric air is deprived of this principle, it is no longer capable of supporting life, and the animal immersed in it instantly dies. It is thus that death takes place from exposure to the fumes of charcoal(*a*), to those of lime-kilns, to the atmosphere of cellars, caverns, wells, and dungeons. (*b*)

The asphyxia from privies, drains, and common sewers, depends upon a different cause, and will be considered under the head of *Sulphuretted Hydrogen*, in the history of poisons.

(*a*) In consequence of plants, in the absence of the sun, giving off nitrogen and carbonic acid gases, the custom of sleeping with flowers in the bed chamber is deleterious, and may even, under certain circumstances prove fatal; a melancholy proof of this occurred in October, 1814, at Leighton-Buzzard, in Bedfordshire. "*Mr. Sherbrook* having frequently had his pinery robbed, the gardener determined to sit up and watch. He accordingly posted himself with a loaded fowling piece, in the green-house, where it is supposed he fell asleep, and in the morning was found dead upon the ground, with all the appearance of suffocation, evidently occasioned by the discharge of *Mephitic gas* from the plants during the night." *Observer* of 16th, and *Times* of 17th October, 1814; see also *Currie's* "Observations on Apparent Death," &c. p. 181.

(*b*) *Rozier* and *Sir Humphrey Davy* conclude from their experiments that carbonic acid kills by exciting a spasmodic action, in which the epiglottis is closed, and the entrance of this fluid into the lungs altogether prevented. *Dr. Babington* appears to entertain a different opinion, (see "a case of exposure to the vapour of burning charcoal," Medico-Chirurg. Trans. vol. I, p. 83,) and asks how we shall explain the fact, that the loss of irritability in the muscles of animals which have been destroyed by immersion in noxious airs, is comparatively greater than in such as are hanged or drowned, unless we suppose that the carbonic acid exerts a deleterious influence on the nervous and muscular systems? The farther consideration of this subject will be more properly entertained under the head of poisons.

The fatal effects of confined air in a small and crowded room, were fully exemplified in the year 1742, when twenty persons were crammed in a part of St. Martin's round-house called the *hole*, during the night, several of whom died; the surgeons on that occasion gave it as their opinion, that when the doors and windows were shut, the place could not support twenty persons for three hours without danger of their lives. A trial took place at the Old Bailey in consequence; but we have not been more successful than *Dr. Gordon Smith* in our search for its report. The medical jurist would be called upon, on such an occasion, for his opinion as to the nature of the deteriorated air, the causes of its accumulation, and whether it was adequate to the production of the alleged effects; and possibly, whether the fatal consequences might not have been averted by judicious caution, or active exertion. The most awful exemplification of the fatal effects of confined air is, however, recorded in the interesting narrative of what happened to the English in the *black hole* at Calcutta; and which we shall briefly relate in this place; as it involves some physiological phenomena to which we shall hereafter have occasion to refer.

It was in the month of June, 1756, that the Viceroy of Bengal laid siege to Fort William, the English factory at Calcutta. *Mr. Holwell*, assisted by the factors and the garrison, defended this post with extreme bravery; but was at length obliged to surrender. There were at this time remaining in the fort, an hundred and forty-five men and one woman. The whole of this unfortunate company, many of whom were wounded, and several very dangerously, were shut up the same night in a small prison only eighteen feet square. This prison, which is now

better known in England by the name of the *black hole*, was enclosed by strong walls, and had only two small windows at one end, secured by iron grates. In this confined situation, which allowed only a space of about eighteen square inches to each individual, the heat and want of fresh air soon excited the most horrible effects; the prisoners, in a state of despair, began by attempting to force open the door, but in this they were unsuccessful. Mr. *Holwell*, who was placed near one of the windows, was more at his ease than the rest, and was consequently more cool and tranquil; and he recommended his companions to be quiet and orderly, and not to exhaust their strength by useless efforts. This advice produced some little calm, interrupted, however, by the groans of the wounded and the dying. The heat increased every moment. Mr. *Holwell* recommended them to strip off their cloaths, as a means of acquiring more space; this was accordingly done, but with no great relief; they attempted to improve this by fanning the air with their hats, but even this was too painful a task for men who were worn out by the fatigue of the siege, and the heat of this dungeon. Another of the company was for their kneeling down, that they might have more air. They all readily agreed to do this; and to rise together in order to avoid confusion. This was done several times, but every time the signal was given to rise, the number of those who had strength enough to obey it diminished. There were constantly some remaining on the floor, who were unable to get up, and these were trodden to death by the survivors. All this happened during the first hour of their imprisonment. At nine o'clock in the evening they began to complain of excessive thirst, and to renew their efforts

to open the prison door, and to tempt the centinels to fire upon them. Some of those who were farthest from the window became at once furiously delirious. The cry for water was unanimous. The guards brought water, and *Holwell* and two of his wounded friends received it at the window in their hats, and were going to pass it on to the rest; but so eager and tumultuous were the efforts of the crowd to get at this water, that *Holwell's* two friends were suffocated, the water was spilt, and *Holwell* saw himself surrounded with dead bodies, who had either been crushed to death, or died for want of fresh air.

Hitherto the commander and benefactor of these unfortunate people, had been treated with some degree of respect, but now all distinction began to be forgotten; the whole company eagerly threw themselves towards the windows, and seizing the iron bars, some of them got even upon his shoulders. He was so borne down by this enormous weight, as to be deprived of all power of motion; he implored the pity of those who were upon his head and his shoulders, and requested them to let him go and die at the bottom of the prison; this request was readily complied with, every one was desirous of succeeding to his place, and without much difficulty he reached the farther end of the dungeon. The third part of these unhappy people were already dead, and they who were still alive pressed so eagerly towards the windows, that *Holwell* found himself somewhat freer in his new station; but the air was so corrupted, that his breathing soon became extremely difficult and painful. Unable therefore to support this, he attempted once more to make his way to the windows; and leaning on a heap of dead bodies, he now resolved to wait patiently for death. In this situation

he remained about ten minutes, and then he experienced such a pain of the breast, and so violent a palpitation of the heart, that he was obliged to make one more attempt towards getting a less fatal air. There were five rows of his companions between himself and the window; his despair carried him through four of these. The palpitation of his heart now began to abate, but he felt inexpressible thirst, and cried out for water; but the water seemed to increase instead of alleviating his thirst; he therefore resolved to drink no more, and rather chose to suck the moisture from his shirt, which seemed to afford him some relief. A young man quite naked, who stood before him, eagerly seized the sleeve of his shirt, and for some moments deprived him of this salutary refreshment. It was not yet midnight. The small number of those who were left, were transported to the greatest excess of rage and despair. They all called aloud for air, because the water that had been brought to them afforded no relief. Soon after this the noise suddenly ceased. The greater part who were living laid themselves down, deprived of all their strength, and peaceably breathed their last. Others aimed at getting into *Holwell's* situation; a Dutchman mounted on one of his shoulders, and a black soldier on the other. In this situation he remained till two in the morning, when he gave up his place to a marine officer, who was soon forced out of it by the Dutchman. The officer retired with *Holwell* to the other corner of the prison, and in a few moments afterwards died. *Holwell* himself was soon deprived of sense, and from that time till sun rise we have no account of what passed. One of those who remained alive, at five in the morning, drew forth *Holwell* from the heap of dead, and found in him

some signs of life; about that time the Viceroy inquired whether he was still alive; he was told, that if the door was immediately opened, it would, perhaps, be possible to recover him, and orders were accordingly given for this purpose. But the door of the prison opened inwards, and they who were within it, and living, were deprived of all their strength, so that more than twenty minutes elapsed before the dead bodies were removed, which prevented the door from being opened.

At a quarter after six o'clock, there came out of this melancholy dungeon three and twenty persons, the remains of the hundred and forty-six who had entered it on the preceding evening.

Upon the events thus related we have to remark, that no advice could be more judicious than that given by *Holwell* to his companions in the early part of their imprisonment—"to be quiet and orderly, and not to exhaust their strength by useless efforts." Nor can we imagine any measure more calculated to increase the sufferings of their situation than that which was subsequently proposed, and adopted, by another of the company, "to fan the air with their hats, and to kneel down and rise together, by a simultaneous motion." It has been satisfactorily established by physiological researches, that the demand for oxygen, in an animal body, will be in proportion to its expenditure by muscular exertions. (*a*) Whenever, therefore, circumstances

(*a*) Comparative anatomy would furnish us with a variety of beautiful arguments, if it were necessary, to support these views. The bird whose muscular exertion is so great during its flight, is provided with a more than ordinary extent of pulmonary apparatus; and amongst insects we find that many of the *coleopterous* species disclose avenues of air, in the act of flying, which, in their quiet state, are closed by the cases

may render a supply of air deficient, we shall best economise that which we possess by perfect quiet. *Lavoisier* says, that a man, under ordinary circumstances, consumes 1300 or 1400 cubic inches of oxygen in an hour, but he found that if he is engaged in raising weights the consumption is at the rate of 3200 in the hour.

Infants appear to be less able to sustain the deprivation of oxygen than adults; and in some cases on record, life has been destroyed by circumstances that we should have *a priori* considered as hardly adequate to such an effect. A case is related of a child, who was suffocated by some drunken men having repeatedly blown out a candle, and held the smoaking wick under its nose. The faculty of Leipsic investigated the circumstances, and declared the death to have taken place in consequence of suffocation. (*Valentini Pand: Med: Legal: Sect: 2.*

6. BY OTHER MODES, NOT INCLUDED IN THE FOREGOING SECTIONS.

We have already stated that if the muscles of respiration be paralysed, the animal can no longer breathe; and it dies in a state of suffocation. There are several mechanical modes by which such a condition may be

of their wings, thus procuring for themselves a larger supply of oxygen, at a period when from their exertions they most require it. Flat fish who, having no swimming bladder, remain at the bottom, and possess but little velocity, have gills that are quite concealed, while those who encounter a rude and boisterous stream, as trout, perch, or salmon, have them widely expanded. For further observations upon this subject, the author begs to refer to his paper in the 10th vol. of the Linnean Transactions, entitled "On the Physiology of the Egg," by *J. A. Paris, M. D. &c.*

produced; a person buried in a heap of ruins, although his head should be free, will perish from the pressure of the surrounding rubbish preventing the due action of the respiratory muscles. It was in this way that criminals who obstinately refused to plead, often died under the pressure of the weights that were heaped upon their bodies. (*a*).

There is a mode of suffocation, described by *Galen*, as being practised by the slaves when brought into the presence of the judges or executioners; it consisted in swallowing their tongue, by which it is said they voluntarily terminated their own existence. Several more modern authors have noticed this incredible mode of suicide, as one that is resorted to by negroes: now to confute such an idea, we have only to shew the attachment of the muscles of this part, and the motions which they permit; equally absurd

(*a*) This was the *peine fort & dure* of our ancient law, which was inflicted on prisoners who stood mute out of malice, or who feigned themselves mad, or challenged peremptorily more than the number of Jurors allowed by law, thus refusing their legal trial. "The manner of inflicting this punishment may be best found from the Books of Entries and other law books, all of which generally agree, that the prisoner shall be remanded to the place from whence he came, and put into some low dark room, and there laid on his back without any manner of covering, except for the privy parts, and that as many weights be laid upon him as he can bear and more, and that he shall have no manner of sustenance but the worst bread and water, and that he shall not eat the same day in which he drinks, nor drink the same day on which he eats, and that he shall so continue till he die." Some authorities say till he answers. See 2 *Hawk. P. C.* 330. *c.* 30. § 16. 4 *Bl. Com. p.* 319. *Jac.* Law Dict. tit. Mute. The memory of this barbarous punishment remains "as a monument of the savage rapacity with which the lordly tyrants of feudal antiquity hunted after escheats and forfeitures," for when the criminal died mute, the lord in some cases lost his escheat; (see 4 *Bl. Com.* 323). But its execution is no longer permitted by our laws. By Stat. 12 *Geo.* 3. c. 20, sentence may be passed on those who stand mute as if they had been found or pleaded guilty.

is it to suppose with other physiologists, that persons can occasion suffocation by a voluntary suspension of their breathing; for if such an attempt were even made, the effort would be ended when self-possession was once lost, for then the impulse of nature must instantly triumph over any struggle to oppose it. We are not, however, prepared to say that such an attempt might not, in certain cases, occasion such a cerebral congestion as to produce apoplexy.

The last cause of suffocation which we have to mention is mechanical obstruction, from the entrance of foreign bodies into the aperture of the glottis; instances of this kind are too numerous and familiar to require many observations: it is thus that *Anacreon* is said to have perished from a grape-seed; *Gilbert*, the poet, terminated his existence in a similar manner; he was a man of great appetite, and in the midst of a festival went into a neighbouring room, but did not return to the great surprise of his convivial companions. He was found stretched on a couch without any signs of life. The assistance administered by his kind but uninformed friends was useless; on opening the body a small piece of mutton was found, that had stopped at the entrance of the larynx, and completely prevented the passage of air into this organ. In Oct. 1821, two inquisitions were taken at Mildenhall, before the Coroner of Bury St. Edmonds in Suffolk; in the one case it appeared that *John Harris* had eaten some honey, from the honey-comb, and that a bee, having been concealed in it, entered the glottis, and occasioned almost immediate death by suffocation; the other case was that of an infant, *Mary Bacon*, who fell with her face upon a quantity of slacked lime, when a particle of it getting into the wind-pipe, produced inflammation of the lungs, and sloughing of

the trachea, of which she died. We have no doubt but that persous, during the state of intoxication, or that of a spasmodic paroxysm, have often perished from suffocation, when the death has been attributed to other causes; if the stomach should reject its contents during a state of insensibility (*a*), such an occurrence is by no means unlikely. We have lately received the history of a case of this description, which occurred in the St. James's workhouse, and fell under the particular notice of Mr. *Alcock*. The patient was seized after a hearty meal of pork with an epileptic fit, during which he died; when upon opening the trachea, it was found to contain a quantity of animal matter resembling the pork upon which he had recently dined.

(*a*) This, however, can but rarely occur; and it seems to have been wisely ordained by Nature, that the stomach should lose the power of rejecting its contents, whenever the brain loses its sensibility. See *Paris's* Pharmacologia, edit. 5, vol. 1, p. 150.

8. DEATH BY EXPOSURE TO COLD.

THAT an animal must perish as soon as the temperature of the medium in which it lives ceases to preserve the blood in a state of fluidity, is one of those self-evident propositions which scarcely requires notice, much less explanation; but that a degree of cold not sufficiently intense to occasion any physical changes upon the constituent parts of the body should extinguish its vitality is a fact, whose history involves some of the most interesting questions of physiology.

The degree of cold, necessary for the production of its fatal effects, varies in a very remarkable degree with the strength and circumstances of the individual to whom it is applied, as well as with the rapidity of the cooling process. In some instances we find that man has endured an extreme degree of cold with but little inconvenience, whilst in other cases, we see him perishing from it in a temperature at which water even retains its fluidity. The interesting history of Sir *Joseph Bankes* (at that time Mr. Bankes), Dr. *Solander*, and eleven others, on a botanical excursion to the mountains of Terra del Fuego; and more recently, the narrative of our enterprizing countrymen, in their voyage to the Polar seas, will furnish a good illustration of the former fact, whilst the melancholy fate of the Cambridge student, as hereafter explained, affords a curious and instructive example of the latter. *Animal heat*, as Mr. *Brodie* observes, *is in some way or other dependant upon the integrity of the functions of the Nervous System*; and consequently the absolute degree of cold which an animal can bear with impunity will, *cœteris paribus*, be determined

by his powers of producing heat; we must therefore cease to regard the fact as extraordinary, that an animal, which is under the influence of a deleterious narcotic poison, or in whom, from any other morbid cause, the powers of the nervous system are exhausted, may be destroyed by a diminished temperature, that would scarcely affect even the sensations of one, differently placed in relation to his nervous energy; thus it is with a person in the last stage of intoxication, in whom the powers of life are ebbing, in consequence of the previous state of morbid excitement; in the course of the last winter, two instances occurred of drunken persons being taken to the watch-house; where, there not being any charge against them, they were dismissed by the constable of the night, and perished in the streets. A military friend has lately communicated to us an instance, where out of a great number of troops who were exposed to intense cold, the only one who perished was under the influence of intoxication; and we learn from *Le Baume's* interesting account of the campaign in Russia, that similar results were observed during the disastrous retreat of the French army on that memorable occasion.

In our own country scarcely a winter passes without the occurrence of some event equally illustrative of this physiological fact; and it is highly important that the medical jurist should be able to appreciate its influence; those who perish in this manner are generally individuals of the most wretched condition, and will be found to have undergone much suffering and privation; by which their nervous energy had been too much exhausted to generate sufficient heat to counteract the diminished temperature of the atmosphere; an event of this nature occurred in London during the winter of 1819, when a man and his

wife, aged persons, and poor, but not supposed, nor indeed proved to have been quite destitute, were found dead in their apartment, although food was discovered in the room, and money was in the pocket of the man: the night (28th of December) had been inclement, and there was neither bed nor fire in the miserable couple's apartment. It appeared in evidence that they had been previously ailing. The verdict recorded that they had perished from the inclemency of the weather, in consequence of the destitute circumstances under which they were found.

It would seem that persons who are long exposed to intense cold do not suffer a painful death; they gradually lose their sensibility, become drowsy, and die as if through the effects of an opiate. Mr. *Brodie** classes the effects of cold in the following order.

1. It lessens the irritability, and impairs the functions of the whole nervous system.
2. It impairs the contractile powers of the muscles.
3. It causes contraction of the capillaries, and thus lessens the superficial circulation, and stops the cutaneous secretion.
4. It probably destroys the principle of vitality, equally in every part, and does not exclusively disturb the functions of any particular organ.

These positions have been confirmed by experiment. Dr. *Chassat* states that in an animal immersed in a cold bath, death may take place at 79° Fahr. (26 *Centig.*), although it may be sometimes cooled down as low as 69° (17 *Cent.*) before it dies; but, *cæteris paribus*, the animal dies sooner as the cooling is more rapid.

* Manuscript Notes.

M. *Portal* thinks that cold produces death by inducing apoplexy, and remarks that the examination of the bodies of persons who have died from cold, proves the presence of sanguineous congestions in the vessels and cavities of the body, and especially in those of the brain. Dr. *Cooke*, however, has remarked that "M. *Portal's* notions on this subject seem to want confirmation. Excessive cold undoubtedly produces, first drowsiness and afterwards a profound sleep, in which the unfortunate individual generally perishes; but we have not on record a sufficient number of cases with particular descriptions of symptoms and appearances on dissection, to enable us to say positively that cold kills by apoplexy."

After death the blood is generally florid in the aorta, so that the animal does not die of suffocation; the heart sometimes contracts feebly after the muscular irritability of the limbs and intestines are nearly destroyed; the cerebral veins contain but little blood; the ventricles contain a small portion of fluid. Mr. *Brodie's* experiments coincide in most respects with those of Dr. *Chassat*, who uniformly found after death, the heart much distended with blood, as in Syncope, scarlet blood occupying the left side; and he also found that the heart ceased to contract before the diaphragm, so that he has seen the animal insensible, and gasp for breath, even after the chest was opened and the heart excised! The muscles were unusually florid, and the peristaltic motions of the intestines were generally observed to continue longer than the action of the heart. The voluntary muscles, he says, lose their irritability in different degrees, those of the legs before those of the thighs, and those of the thighs before the abdominal muscles.

DEATH BY THE AGENCY OF HEAT.

We have not yet a sufficient number of well reported experiments on the effects of heat on animals, to enable us to draw any satisfactory conclusions respecting the mode in which life is destroyed by this agent; although it seems probable that it acts by destroying the muscular energy of the heart and diaphragm. (*a*)

Mr. *Brodie* placed a rabit in a basket in an oven, the temperature of which was not more that 150°, and it died in a few minutes without any apparent suffering; the heart was afterwards found distended with blood, on both sides, as in Syncope.

DEATH BY LIGHTNING.

It has been incontrovertibly established by the experiments of modern philosophers, that the phœnomena of electricity are identical with those of thunder and lightning. The human body is alike affected by both; and death, whether it be occasioned by the discharge of an electrical battery, or by that of a thunder cloud, exhibits effects precisely analogous.

Mr *Hunter* supposed that when death is thus occasioned, there is an instantaneous and entire annihilation of the vital principle, in every part of the animal machine; and that the muscles are therefore relaxed, and incapable of contraction, that the limbs do not stiffen (*b*), as in other cases of death, nor the blood

(*a*) *Dr. Badenoch* has very satisfactorily shewn that the *Coup de Soleil* kills by producing apoplexy.

(*b*) This does not hold universally, for *Beccaria* mentions the case of a man whose body became exceedingly stiff, very shortly after having been struck dead by lightning;—and in one of Mr. *Brodie's* experiments, the muscles of a Guinea pig killed by electricity became stiff.

coagulate, and that the body very speedily runs into a state of putrefaction. The experiments however of Mr. *Brodie* (*a*) will induce us to pause, and institute farther enquiries before we receive this theory as unexceptionable. It will appear that in the following experiments of this physiologist, an instantaneous extinction of vitality did not take place, but, on the contrary, the functions of the brain were those on which the electric shock exercised its primary influence. An electric battery of six jars having been charged with electricity, the shock was made to pass through a Guinea pig, in the longitudinal direction from the head to the tail: the animal immediately fell on one side, insensible, as if stunned; a convulsive action of the muscles of the extremities was observed, but did not long continue; and the function of respiration was not interrupted. In a few minutes sensibility was restored, and the animal recovered. A shock from a battery of nine jars was then passed in the same manner through another Guinea pig; the animal immediately fell on its side, exhibited a convulsive action of the voluntary muscles of the limbs, but uttered no cries, and although attentively watched, no signs of respiration could be discovered after the shock had passed through it. Three minutes afterwards, Mr. *Brodie* opened the chest, and found the heart acting with regularity and vigour, about 80 times in a minute, and circulating dark coloured venous blood; the peristaltic motion of the intestines was likewise visible; and the muscles, when made the part of a galvanic circuit, readily contracted. In this experiment, observes Mr. *Brodie*, it is evident that the electric shock did not destroy

(*a*) Manuscript Notes.

the irritability of the muscular fibre, nor did it affect the action of the heart. *Death took place precisely in the same manner as from a severe injury of the head*; and the animal died, manifestly from the destruction of the functions of the brain; and, in this case, Mr. *Brodie* has no doubt, but that if the lungs had been artificially inflated, the action of the heart might have been maintained, and the animal probably have been restored to life.

The nature and extent of the injury inflicted by lightning, depend upon the intensity and direction of the electrical discharge, and vary greatly in degree; by far the greater number of flashes are harmless discharges from one cloud to another, and the instances in which it strikes the earth are comparatively rare: when however this does occur, and it directs its course through a human being, it may expend its influence upon the surface, and produce partial or general vesications. (*a*) Sometimes the clothes of the person have been violently rent, and the metallic substances about them melted; or it may pass through the body, without including the clothes, and it may occasion death without injuring the organic structure of any part of the body: or it may pass through only a particular portion of the body, and produce local injury.

But it has happened that persons have been struck when the tempest has appeared to be at a considerable distance; this has been explained by Signor

(*a*) *Mayer* directed his attention very particularly to the appearances which were thus produced, and had drawings made of them. It would appear that they most commonly passed in the direction of the spine.

In the First Volume of the Philosophical Transactions, there is an account of the dissection of a man killed by lightning, but it contains nothing remarkable.

Beccaria, by supposing that it is a discharge of electric fluid from the earth, occasioned by the passing of a cloud that has just before, in the elemental strife, been rendered negatively electric. Lord *Stanhope* distinguishes such a discharge by the name of the *Returning Stroke.* (*a*)

As a provision for personal security during a thunder storm, a few precautions are necessary, and we are induced to notice them in this place, as their history is necessarily involved in our enquiries concerning death by lightning. In the open air, shelter ought not to be sought immediately under trees, for should they be struck, such a situation would be attended with the most imminent peril: on the contrary, the distance of twenty or thirty feet from such objects, may be considered as affording a place of safety, for should a discharge take place, they will most likely receive it, and the less elevated bodies will escape. Any surface of water, and even the streamlets that may have resulted from a recent shower should be avoided, for being excellent conductors, the height of a man, when connected with them, is very likely to determine the course of an electrical discharge. The partial conductors, through which the lightning directs its course when it enters a building, are usually the appendages of the walls and partitions; the most secure situation is therefore the middle of the room, and this situation may be rendered still more secure by lying on a hair mattress, or even on a thick woollen hearth rug. The part of every building least likely to receive injury is the middle story, as the lightning does not always pass from the clouds to the earth, but is occasionally dis-

(*a*) See also an account of a thunder-storm, by Mr. *Bryâone*, in the 77th vol. of Phil. Trans.

charged from the earth to the clouds, as in the case of the "*returning stroke;*" hence it is absurd to take refuge in a cellar, as recommended by Dr. *Priestley*; indeed many instances are on record, in which the basement story has been the only part of a building that has sustained severe injury, the electric charge being divided and weakened as it ascended. Any approach to a fire-place should be particularly avoided, for the chimneys are very likely to determine the course of the lightning; the same caution is necessary with respect to gilt furniture, bell-wires, and moderately extensive surfaces of metal of every description.

DEATH BY STARVATION.

That a living animal body cannot long survive without the ingestion of alimentary matter, is too self-evident to require demonstration. Living bodies, says *Cuvier*, may be considered as a kind of furnaces into which inert substances are successively thrown, which combine among themselves in various manners, maintain a certain place, and perform an action determined by the nature of the combinations they have formed, and at last fly off in order to become again subject to the laws of inanimate nature.

It must, however, be observed, that there is a difference, depending on age and health, in the proportion of the parts which enter into the current, and those which abandon it; and that the velocity of the motion usually varies according to the different conditions of each living body; hence it follows, that the period during which an individual may exist without food, will be liable to variation. We have already stated (page 394) that, *cæteris paribus*, he will perish from inanition with a rapidity proportioned to his youth,

and state of robust vigour; and we remarked in what strict conformity with physiological principles the poet *Dante* had described the fate of *Ugolino* and his family. (*a*) The same fact appears also to have been well understood by the ancient physicians; (*b*) equally evident is it that women are able to support abstinence longer than men. It has been also observed that a moist atmosphere contributes to the protraction of life, under circumstances of privation; this may depend, not only upon the fluid matter thus furnished to the body, but upon the non-conducting power of the medium, in relation to aqueous vapour; the ingestion of a very small proportion of water revives in an extraordinary degree, the animal perishing from famine, and prolongs his existence. *Redi* (*c*) instituted a series of experiments with the sole view of ascertaining how long animals can live without food. Of a number of capons which he kept without either solid or liquid food, not one survived the ninth day; but one to which he allowed water, drank it with avidity, and did not perish until the twentieth day. *Elizabeth Woodcock*, who was buried under the snow, near Cambridge, for the space of eight days, undoubtedly owed her preservation to the snow which she occasionally sucked. (*d*)

Those cases of extraordinary fasting, which are recorded in the different Transactions and Journals of almost every country, are to be generally regarded as

(*a*) *Morgagni* de Sedibus et Causis Morb. Epist. 68. No. 6 and 7.

(*b*) *Hippocrat.* Aphor. 13. Sect. 2.

(*c*) Osservaz: intorno agli Anim. viventi, etc. No. 3 et 4.

(*d*) This event occurred during the period of the author's studies at Cambridge; and he can therefore offer his testimony to the truth of the statement; he visited the woman soon after her disinterment.

gross impositions; we (*a*) have already exposed the fallacy of several of the more popular histories of this kind. Such impostors, however, in their attempt to delude the world, have unintentionally offered themselves as the voluntary victims of physiological experiment; for we have at least learnt from them how small a portion of aliment is sufficient to preserve the life of a human being; a fact which had never before been satisfactorily proved, however probable it had been rendered, by the recorded habits of many of the early Christians, especially those of the East, who retired from persecution into the deserts of Arabia and Egypt.

The sufferings of a person perishing from inanition (*b*) must be considered as the most acute that can befal humanity; and yet we have instances on record of their having been voluntarily encountered as the means of suicide; a very interesting and well-authenticated instance of this kind has been related as having occurred in Corsica; (*c*) and, as it is calculated to afford, at once, a history of the symptoms of Starvation, and an exemplification of their severity, we shall introduce a brief account of the case in this place. *Luc Antoine Viterbi* was condemned to death as an accomplice in the assassination of *Frediani*, a crime which he denied to the last moment,

(*a*) See Vol. i. p. 369.

(*b*) Starving to death was a punishment inflicted by the people of Aragon, some years ago; and it is reported by *Tavernier*, that the chief ladies in the kingdom of Tonquin, are at this day starved to death for adultery. The severity of the Roman law on an unchaste Vestal has often exercised the pencil of the artist. An account of its execution on *Rhea*, marked as it always was by circumstances of peculiar horror and solemnity, is to be found in *Plutarch's* Life of *Numa*; the offender, conducted by a mute procession across the Forum to the place of her interment near the Colline gate, was made to descend a ladder into the sepulchre, and left there with a lamp, a loaf of bread, and a cruse of water, the opening being immediately closed with earth and stones.

(*c*) Corsican Gazette, and London Med. & Phys. Jour. March, 1822.

and appealed against a sentence passed upon him by a Court composed of his personal enemies. Towards the end of November, *Viterbi* (knowing his condemnation, and being confined in the prison of Bastia), resolved to die. To effect his purpose, he abstained from food for three days, and then ate voraciously, and to a forced excess, in the hope that, after fasting so long, he should thereby put an end to his existence; in this however he was deceived, and, on the second of December, he determined to starve himself to death; from that day nothing could shake his awful resolution, although he did not expire until the night of the 21st of that month. During the three first days, *Viterbi* felt himself progressively tormented by hunger; under these circumstances a report was made to the public minister, who ordered bread, water, wine, and soup to be taken daily to his cell, and placed conspicuously in view. No debility was manifested during these three days, no irregular muscular movement was remarked, his ideas continued sound, and he wrote with his usual facility, but took no nourishment.

From the 5th to the 6th, to hunger insensibly succeeded the much more grievous suffering of thirst, which became so acute, that on the 6th, without ever deviating from his resolution, he began to moisten his lips and mouth occasionally, and to gargle with a few drops of water, to relieve the burning pain in his throat; but he let nothing pass the organs of deglutition, being desirous not to assuage the most insupportable cravings, but to mitigate a pain which might have shaken his resolution. On the 6th, his physical powers were a little weakened; his voice was nevertheless still sonorous, pulsation regular, and a natural heat equally extended over his whole frame. From

the 3d to the 6th, he had continued to write; at night several hours of tranquil sleep seemed to suspend the progress of his sufferings, no change was observable in his mental faculties, and he complained of no local pain. Until the 10th, the thirst became more and more insupportable; *Viterbi* merely continued to gargle, without once swallowing a single drop of water; but in the course of the 10th, overcome by excess of pain, he seized the jug of water, which was near him, and drank immoderately. During the last three days, debility had made sensible progress, his voice became feeble, pulsation had declined, and the extremities were cold. *Viterbi*, however, continued to write; and sleep, each night, still afforded him several hours ease.

From the 10th to the 12th the symptoms made a slight progress. The constancy of *Viterbi* never yielded an instant; he dictated his journal, and afterwards approved and signed what had been thus written agreeably to his dictation. During the night of the 12th, the symptoms assumed a more decided character, debility was extreme, pulsation scarcely sensible, his voice extraordinarily feeble, the cold had extended itself all over the body, and the pangs of thirst were more acute than ever. On the 13th the unhappy man thinking himself at the point of death, again seized the jug of water, and drank twice, after which the cold became more severe; and congratulating himself that death was nigh, he stretched his body on the bed, and said to the gendarmes who were guarding him, "Look how well I have laid myself out." At the expiration of a quarter of an hour, he asked for some brandy; the keeper not having any, he called for some wine, of which he took four spoonsful; when he had swallowed these the cold suddenly ceased,

heat returned, and *Viterbi* enjoyed a sleep of four hours. On awaking (on the morning of the 13th) and finding his powers restored, he fell into a rage with the keeper, protesting that they had deceived him, and then began beating his head violently against the wall of his prison, and would inevitably have killed himself, had he not been prevented by the gendarmes. During the two following days he resisted his inclination to drink, but continued to gargle occasionally with water; during the two nights he suffered a little from exhaustion, but in the morning found himself rather relieved. It was then that he penned some stanzas. On the 16th, at five o'clock in the morning, his powers were almost annihilated, pulsation could hardly be felt, and his voice was almost inaudible; his body was benumbed with cold, and it was thought that he was on the point of expiring. At ten o'clock he began to feel better, pulsation was more sensible, his voice strengthened, and, finally, heat again extended over his frame, and in this state he continued during the whole of the 17th. From the latter day until the 20th, *Viterbi* only became more inexorable in his resolution to die. During the 19th, the pangs of hunger and thirst appeared more grievous than ever; so insufferable, indeed, were they, that for the first time, *Viterbi* let a few tears escape him; but his invincible mind instantly spurned this human tribute. For a moment he seemed to have resumed his wonted energy, and said, in the presence of his guards, and the gaoler, "I will persist, whatever may be the consequence; my mind shall be "stronger than my body; my strength of mind does "not vary, that of my body daily becomes weaker." A little after this energetic expression, an icy coldness again assailed his body, the shiverings were frequent

and dreadful, and his loins, in particular, were seized with a stone-like coldness, which extended itself down his thighs. During the 19th a slight pain at intervals affected his heart, and for the first time, he felt a ringing sensation in his ears; at noon, on this day, his head became heavy; his sight, however, was perfect, and he conversed almost as usual, making some signs with his hands.

On the 20th, *Viterbi* declared to the gaoler and physician, that he would not again moisten his mouth; and feeling the approach of death he stretched himself, asking, as on a former occasion, whether he was well out, and added "I am prepared to leave this world." Death did not this time betray his hopes. On the 21st *Viterbi* was no more.

In this interesting history, we receive a faithful account of the physical effects of starvation upon a human being, and perceive how greatly a very inconsiderable portion of liquid is capable of producing an invigorating effect upon the body, when in a state of extreme inanition; but the mind of the subject before us was stern and invincible, inflexibly bent upon self destruction; and we therefore do not perceive the developement of those moral effects, which in other cases are the general consequences of starvation. The histories of besieged towns(*a*) would afford us ample evidence upon this subject; and would shew that famine destroys all the most powerful instincts of our nature. We know not, however, a more awful illustration of this fact than that furnished by the account of the wreck

(*a*) The siege of Jerusalem by the Romans will at once occur to the reader; and of which *Josephus* has left us so tragic a history; amongst other atrocities, an unhappy woman, reduced to the last extremity by pinching hunger, sacrifices the feelings of a mother to the voracious calls of appetite, butchers her child, and feeds upon the body!

of the *Méduse*, (*a*) and its appalling consequences; it appears that this frigate struck on the bank of Arguin, and as all attempts to save her were fruitless, nothing remained but to concert immediate measures for the escape of the passengers and crew; five boats were accordingly got in readiness, and a raft, destined to carry the greatest number of people, was hastily constructed; biscuit, wine, and fresh water were also apportioned to each; but in the tumult of abandoning the wreck, it so happened that the raft had the least share of the provisions, and in which there was not a single barrel of biscuit. This raft, containing no less than one hundred and fifty souls, was to have been towed by the boats, with which it was connected by ropes; but the adventurers had not proceeded far, when the boats cast off, and cruelly abandoned the raft to the mercy of the ocean; to the scene which ensued it is impossible for any language, however florid, to do adequate justice. Despair, aided by the pangs of hunger, soon excited a mutiny; a dreadful slaughter ensued, and the flesh of their murdered comrades afforded to the survivors a short respite from the immediate sufferings of famine.

(*a*) See "Naufrage de la Frégate la Méduse, faisant partie de l'Expedition du Sénégal en 1816, par *F. B. Savigny*, ex Chirurgien de la Marine, et *Alexandre Corréard*, Ingénieur-Geographe. Paris, 1817.—A very interesting account of this narrative may be found in the Quarterly Review, for October, 1817.

THE APPLICATION OF THE PHYSIOLOGICAL FACTS ESTABLISHED IN THE PRECEDING CHAPTERS, TO THE GENERAL TREATMENT OF ASPHYXIA.

ALTHOUGH our researches into the causes and phenomena of asphyxia, or suspended animation, will afford, on many occasions, but very scanty encouragement with regard to the extent and value of the resources of art, yet we apprehend that to the intelligent practitioner they will not on that account be less acceptable; for to him it must be well known, that the detection of error is the first step in the discovery of truth, and although the tendency of the present investigation will be to reject, as useless, many of those plans of treatment which have long enjoyed the confidence of the public and the profession; yet it will suggest the application of some that have not hitherto been duly appreciated, and regulate that of others whose efficiency entirely depends upon the time and manner of their administration. But the fact is not to be concealed, that the medical profession, as well as the public, have long been too sanguine in their estimate of the probabilities of recovery by art, in cases were life is suddenly arrested by the operation of external causes; and upon this occasion, the establishment of the "ROYAL HUMANE SOCIETY for the recovery of persons apparently dead," requires some notice, in relation to the possible extent of its successful exertions. Without some explanation it will be

impossible to reconcile the reports of that philanthropic institution, with the physiological views which we have attempted to establish in the present work; it therefore becomes a part of our duty to explain the nature of the fallacies into which the witnesses and reporters of cases of suspended animation appear to us to have been unconsciously betrayed, and which have so frequently bestowed upon fable the colour of truth, and given to vague report, the apparent stability of credible testimony. In the first place we would observe, that in those cases in which a long interval is stated to have occurred between the suspension of breathing, from drowning, and the restoration of that function by art, it is probable that the anxiety of by-standers who witnessed the struggles, and the impossibility of justly appreciating the lapse of time in such moments of anxiety (*a*) and distress, have led to the erroneous statements with which the subject is embarrassed. There is, moreover, another fallacy into which the anxious observer is very likely to fall,—the sufferer may have breathed unobserved during the alleged interval of asphyxia; and if this fact be admitted, we at once reduce some of the most incredible of these reports to the rational

(*a*) That which we call duration is in fact a feeling of succession, and is computed by the number of ideas that pass through the mind; whenever an event occurs which powerfully excites the attention of an observer, he watches the most minute change, whence he believes that the time which elapses before the whole event is completed, appears to be unusually prolonged. When the infidel sultan of Egypt refused to believe that Mahomet could have ascended into the seven heavens, and have held some thousand conferences with the Almighty in the space of a few minutes, the learned mussulman, who was consulted on the occasion, endeavoured to turn his Majesty to a more strict faith, by demonstrating to him that a short period of time became converted into a long one, when a great multitude of important events were crouded into it.

standard of physiological probability. Nor shall we hesitate in the present chapter to offer our remarks upon the plan of recovery proposed by this society with as much freedom, and as little reserve, as we have ventured to question the literal accuracy of their reports. But while, thus fortified by physiological arguments, we profess to discredit many of the results stated by this society, let it not be supposed that we would prefer a charge of insincerity against their authors, or attempt to withhold any portion of that public patronage and consideration, to which their zeal and philanthropy so justly entitle them.

The agents which are employed in cases of suspended animation, are far too indiscriminately recommended; some of them, without doubt, offer valuable resources to the physician, and only require a judicious application to ensure their success; while others are entirely useless and frivolous, and ought to be dismissed from our service, since the retaining them only embarrasses the practitioner, and that too at a period which of all others requires the utmost decision in the selection of a plan of treatment, and the greatest promptness in its execution.

The following may be considered as the principal resources upon which the *Humane Society* rely for restoration of persons apparently dead from sudden accidents, viz.

1. *Inflation of the lungs.*
2. *Application of heat.*
3. *Internal Exhibition of stimulants.*
4. *Friction.*
5. *Electricity.*
6. *Exposure of the surface of the body to cool air.*
7. *Blood-letting.*

We shall offer a few observations upon the methods of applying these agents.

On the manner of producing artificial respiration.

We are indebted to *Mr. Brodie* for the valuable directions that are to guide the execution of this important operation. *(Manuscript Notes.)* A common pair of bellows will be found as manageable and efficient an apparatus for the inflation of the lungs, as any instrument that could be contrived; those manufactured for the service of the Humane Society are not of a size sufficient to inflate the lungs of even a large dog, much less those of man; nor is it necessary to employ double bellows on this occasion, for the air will escape from the lungs without being withdrawn by suction; besides which, it is stated that the forcible exhaustion of the lungs is liable to occasion pulmonic hemorrhage. It has been proposed to insert the tube of the bellows into the trachea, by means of a wound in that structure, but there are great objections to such a proceeding; the hemorrhage which is likely to occur, (*a*) may inundate the windpipe; besides which,

(*a*) In a tract entitled "Observations on Animal Life and Apparent Death, by *John Franks*, surgeon, 8vo. London, 1790," the author says that "when the late *Mr. Justamond* (Surgeon to the Middlesex hospital) lived on the terrace, Palace yard, Westminster, a boy who had been drowned in the Thames was brought to him; he made an opening into the wind-pipe, in order to inflate the lungs; but the discharge of blood which ensued was such as gave him no chance of succeeding in the recovery; for he could not prevent the blood from pouring down into the lungs." Although, says *Dr. Currie*, nothing is said in this case about the pulse, yet from the blood flowing so copiously, there is reason to believe that the heart had begun to act; and therefore to conclude, that life was in fact *destroyed* by this operation, which *might* have been saved

the operation occasions delay, which, however trifling, will be important in cases where the action of the heart has become much enfeebled; and moreover the wound itself is an evil which ought to be avoided, if artificial respiration can be established without it; and were these objections even overruled, there still remains another; experience has shewn that the air thus introduced issues by the opening of the larynx, without having dilated the lungs.

A tube may be constructed for the purpose of being inserted through the mouth into the *rima glottidis*; if the patient be sensible, the introduction of such a tube might be difficult; but as the patient is in a state of insensibility, the introduction may usually be effected without much difficulty, but not altogether without trouble; for the mere circumstance of having to open the mouth, to pull forward the epiglottis, to direct the tube into the proper aperture, may occasion delay which will be of importance in cases where success depends upon the skill with which the time has been economised.

It is for such reasons more expedient to inflate the lungs by means of a tube inserted into one nostril, keeping the other and the mouth carefully closed: the bellows having been thus disposed, the air should be driven into the lungs with a certain degree of force; the lungs will thus become fully inflated, and in the intervals between the different inflations, the air from the lungs will escape by the mouth and by the other nostril, and when the lungs are thus

without it. See "Observations on Apparent Death from Drowning, Hanging, Suffocation by noxious vapours, &c." by *James Currie*, M.D. London, 1815.

emptied, the process may be repeated. There is but one objection to this method of exciting artificial respiration, viz. that at each inflation, a portion of air will sometimes find its way into the stomach, through the œsophagus: it is very desirable to prevent such an occurrence, for when the stomach is much distended with air, the descent of the diaphragm is prevented, and, consequently, a perfect inspiration cannot be accomplished. The passage of air into the stomach may be prevented by pressing on the thyroid cartilage, so as to close the communication between the pharynx and œsophagus. All that is necessary for the operator is, to produce the inspiration; we are recommended indeed to press the margin of the ribs gently upwards, so as to expel the air, and produce expiration; but this is altogether unnecessary, for the elasticity of the ribs, and the pressure of the abdominal muscles and viscera, and the elasticity of the lungs themselves, are quite sufficient to occasion the expiration without any assistance from external pressure. We must not omit to state that the inhalation of oxygen gas, instead of common air, has been strongly recommended, not only as being in itself a more powerful stimulus, but as being more efficient in the removal of the accumulation of that carbonized matter which, under ordinary circumstances of respiration, is regularly thrown off; the practical eligibility however, of such a plan is very questionable, and to say nothing of the difficulty of obtaining oxygen upon an occasion where the least delay is fatal, it is very doubtful whether the effects of this gas are really such as our theory would at once lead us to believe. We have deemed it necessary to enter into these details, in order to afford some practical instruction upon a subject of manipulation but little understood,

but which is undoubtedly the most valuable of all the resources which art can furnish for the preservation of human beings that are in danger of perishing from accidental causes. The principal circumstances to be remembered are comprised in the following precepts.

1. The lungs are to be sufficiently, but not too much inflated.
2. The inspiration must be made of sufficient frequency.
3. The air is to be allowed a free exit from the lungs, so that the same air shall not be transmitted more than once.
4. The method of inflating the lungs must be simple, and easy of adoption; for as the interval of time, during which the artificial respiration can possibly be of any service, is very limited, it is important to avoid whatever may occasion the least delay.

Application of Heat.

There is perhaps no medium through which we can more successfully apply heat to the human body than that of the bath, because we can manage its application with precision; we know the exact degree of heat, and can avoid applying it in extremes; we, at the same time, can communicate it more rapidly, and more equally, than by any other means, and we are enabled to increase or diminish the temperature, by the addition of fresh portions of water, as circumstances may render it expedient.

Internal Exhibition of Stimulants.

The introduction of fluids into the stomach is not an easy process in many cases of suspended animation, as *trismus* is by no means an uncommon occurrence; where, however, the spasm of the jaw has subsided, the practitioner with a little address may by means of a flexible tube easily accomplish his object. Glysters will likewise furnish an easy mode of applying stimulants.

Electricity.

No sooner was the discovery made that galvanism is capable of exciting muscular contraction in animals apparently dead, than the physiological enthusiast seized it with avidity, and at once hailed it as the long desired influence that was to restore vigour to the enfeebled, and resuscitation to those that were in a state of suspended animation. It had been long known that muscles could be made to contract, by irritating the nerves belonging to them with the point of the scalpel, but not in a degree that remotely approached the vigorous contractions occasioned by the galvanic influence, whose stimulus seemed almost equivalent to that of volition. The sanguine expectations, however, which were thus very naturally excited, have ended in the most complete disappointment; and we are bound to confess that although *galvanism is capable of exciting extraordinary contractions in the* VOLUNTARY *muscles, and of astonishing the multitude, yet its influence does not extend to those that are* IN-

VOLUNTARY. *Bichat* states distinctly that *the involuntary muscles are beyond the reach of galvanism.* (*a*) Mr. *Brodie* has frequently attempted to restore the heart's action by the galvanic stimulus, in an animal dead from syncope, but never with success. The author of the present work may add, that he has attempted the same object by modifying the experiment in several different ways, but with no better success. But it may be said that, as galvanism will excite the contractions of the diaphragm, and other muscles of respiration, it may be made subservient to the purpose of producing artificial respiration: granted,—but it never can be made to act with the certainty, regularity, promptness, or convenience, which attend the operation of a common pair of bellows, nor even if it could, would any advantage be obtained which might not be equally insured by the use of this latter simple instrument. It is, moreover, questionable whether so powerful a stimulus may not produce a subsequent exhaustion of the muscular energy; such effect indeed would appear to have happened in the case related by Dr. *Babington*, where the asphyxia had been occasioned by the fumes of burning charcoal; "having passed," says he, "a galvanic shock through the chest, the patient instantly, to our surprise, drew his breath deep; the muscles of the abdomen were seen to react, though feebly, while those of the face were slightly convulsed, and the eyelids were raised; at each successive application of this powerful agent, the respirations were more forcibly performed, and the

(*a*) The first body galvanised in this country was that of the malefactor *George Foster*, who was executed in January 1803, before Newgate, for the murder of his wife and infant daughter, by drowning them in the Paddington Canal; the experiment was conducted under the direction of *Aldini*, the nephew of *Galvani*.

stroke of the artery at the wrist rose in the same proportion. Having procured a bladder filled with oxygen gas, we caused it to be inspired, and we thought that it was followed by an increased activity of the powers of respiration and circulation; as the heat of the body was not deficient, we now sprinkled the face and chest with cold water, which also had the effect of rousing the dormant powers of sensation, as the respiratory muscles were uniformly thrown by it into action, though in a more feeble and interrupted manner than when we employed the galvanic influence. Having received a large supply of oxygen gas, we repeated the inhalation and the galvanic succussions alternately, through the chest and head, every half-hour, for three hours, when the galvanic influence was discontinued, as the heart, though uniformly excited by it, seemed in the intervals to act more feebly, and we were apprehensive that by exalting the action of one power continually, we might destroy that equilibrium of forces which is necessary to the maintenance of life." (*a*)

TREATMENT OF PARTICULAR CASES OF ASPHYXIA.

CASE I.

Wherein the action of the heart fails before that of the respiratory organs.

In no case of this description can artificial inflation of the lungs afford the least assistance, for the left side of the heart always contains florid blood at the

(*a*) *Medico-Chirurg. Trans.* vol. 1, p. 26.

moment of its cessation; and since this fact proves that it failed in its action, while under the full influence of duly oxygenized blood, how can we expect that the stimulus, which was unable to preserve the heart's action while yet in motion, shall be able to re-excite it after it has ceased? Such a practice can only have been suggested by that erroneous physiology which maintained that the motion of the lungs excited that of the blood.

The preservation of the body from the influence of external cold is always important, for it is only within a certain range of temperature that the vital functions can be performed; and during a state of asphyxia, the body is necessarily incapable of generating any portion of animal heat; where the heat is lost it should be gradually restored, and for such a purpose the introduction of wine, the volatile alkali, and other stimulants, into the stomach, by means of a flexible tube, would probably, in certain states of syncope, prove serviceable; although in cases of suffocation it can never occasion the least benefit. We have been also directed to employ frictions on the surface of the body, for the purpose of assisting the circulation of the blood; as if, says Mr. *Brodie*, (*Manuscript Notes*) this could answer any useful purpose where the action of the heart has ceased, or as if it could be necessary where it still continues.

Under the head 'death from cold,' we have stated that the left cavities of the heart contain florid blood; it therefore follows that the directions of the Humane Society, to inflate the lungs in such cases, are founded in error.

CASE II.

Wherein the function of respiration ceases, while the heart continues to circulate black blood.

It has been stated that in cases of suffocation the heart continues to contract for a short period, after the cessation of breathing; that this interval is extremely short, but liable to vary from several causes; and that it is uniformly shorter in cases of death by drowning, than in those by strangulation. To the physician this is an interval of anxiety and importance; let him beware how he trifles with the fleeting moments, in which alone the resources of his art can be of any avail. If artificial respiration be established at this period, the blood will become once more oxygenised, the action of the heart will be continued, the scarlet blood will be transmitted to the brain, and sensibility will therefore return; the nervous energy will be once more transmitted to the respiratory organs, and the animal will at length make a voluntary effort to inspire air. Here then is the interval of time, during which artificial breathing may be employed so as to effect a restoration to life, where death must otherwise have been inevitable. Mr. *Brodie* has made a great variety of interesting experiments upon this subject, from which may be deduced the following important corollaries.

1. If the lungs be inflated, the action of the heart will continue.

2. If the action of the heart has become feeble, but the circulation is nevertheless not entirely suspended, the inflation of the lungs will cause the

feeble actions to become again frequent and vigorous.

3. If the action of the heart has entirely ceased, it is impossible to restore it by the inflation of the lungs.

4. If the action of the heart has not entirely ceased, but is so feeble as no longer to maintain the circulation, the artificial respiration will prove as useless, as if the heart were perfectly motionless.

There is still, however, another period at which artificial respiration may be employed with the greatest advantage; we have stated that after the natural respiration has been re-established, and the animal would appear to be advancing towards recovery, it not unfrequently relapses into a state of insensibility, becomes convulsed, and dies. As this depends upon the black blood which is circulating through the brain, so paralysing that organ as to prevent a necessary transmission of its influence to the muscles of respiration, life may be preserved if artificial respiration be established until the brain is again supplied with duly oxygenized blood; after which the animal will be enable to perform its own functions without any assistance from art.

The same treatment will, of course, apply in every case where the natural respiration ceases in consequence of being deprived of a due supply of nervous energy, from the insensibility of the brain; as from a blow on the head—the action of a narcotic poison—from lightning?

It has been proposed, in cases of suffocation, to take away blood from some of the larger veins; as far

as relates to the asphyxia, no advantage can accrue from such a practice, but incidental benefit may arise where congestion has taken place in the brain, as happens in hanging: in such cases the jugular veins are those from which the blood can be taken with the greatest chance of success.

Advantage is also said to accrue from the application of volatile alkali, or other pungent bodies to the inside of the nostrils; whatever promotes sneezing or coughing is supposed to give a succussion to the diaphragm and its antagonist muscles, and thereby to promote the re-establishment of respiration.

Cordials, moderate warmth, and quiet, are the resources upon which we are to rely for the ultimate recovery of the vital powers, after the complete establishment of the function of respiration.

For a long period, injections of tobacco enjoyed a high, but unmerited reputation amongst the medicinal agents that were supposed capable of rousing the latent energies of life, in cases of suspended animation; and strange as it may appear, this most powerful narcotic poison, until within a few years, was annually recommended for such purposes by those who professed to instruct the profession and the public upon these important topics; this may be considered as one of the most stupendous errors that ever occurred in the exercise of the medical art.

Where the asphyxia has arisen from the inhalation of noxious vapours, as those emitted by burning charcoal, the exposure of the body to cold has been strongly recommended. In Russia, where from the mode of heating the dwellings, accidents of this kind very frequently occur, the general practice is to rub the body with snow, and it is said with the happiest effect; this plan, says Dr. *Babington*, is probably of

use, from the strong impression which is made upon the skin as a sentient organ. It is also a well known fact, that the recovery of the dogs which are made the subjects of experiment in the *Grotto del Cane*, is much favoured by their being plunged into a neighbouring lake.

Is it necessary to repeat, that the idea respecting the presence of any considerable portion of water in the lungs of a drowned person, has no foundation in truth? we should have scarcely deemed the notice of such a fallacy, and that of the practice founded upon it, of hanging by the heels, called for in this place, had not an opinion been lately delivered, by a medical witness, that *a person drowned in the Thames might possibly have been recovered, but for the impurity of the water, arising from the gas-works.* We have only to observe upon this occasion, that had the individual in question recovered in the hands of a practitioner who could have delivered so absurd an opinion, he would have been more indebted to good fortune than to skilful attention.

A drowned animal will, in general, be recovered more slowly and with greater difficulty than one which has fallen into a state of asphyxia from strangulation. It is probable that, in the former case, the sudden reduction of temperature will contribute to the more rapid extinction of vitality.

Having thus examined the pretensions to which the several modes of restoring animation are entitled, we may conveniently introduce in this place some observations upon the different methods which have been adopted to secure condemned criminals against the fatal effects of their execution. There can be no doubt but that by making an opening in the trachea, below the ligature, death might in some cases be

prevented, provided the neck were not dislocated, nor the weight of the body very considerable. *Richerand* says, that a surgeon of the imperial armies, whose veracity cannot be questioned, assured him that he had saved the life of a soldier by performing the operation of laryngotomy some hours before he was executed.

Dr. *Male* (*a*) states that it was tried on one *Gordon*, a butcher, who was executed at the Old Bailey in the early part of the last century; the body having hung the usual time, was removed to a neighbouring house, where a surgeon waited to receive it, and enforce every means calculated to restore animation: he opened his eyes, and sighed, but soon expired: the want of success was attributed to his great weight, but we apprehend that, if the statement be correct as to his opening his eyes and sighing, the failure must have depended upon want of skill in the operators. We have yet to notice those cases of spontaneous recovery which have taken place after execution, and which are too well authenticated to admit of doubt; upon this point we would observe, that such results by no means militate against the accuracy of the physiological views which have been already presented to our readers. Whenever such a recovery occurs, the strangulation has never been complete, and feeble motions of the heart have been preserved by imperfect and occasional respirations, during the interval of suspension; this may depend, in a great measure, upon the situation of the noose; if placed at the side of the neck, it would be pulled tight by the weight of the body; but if at the back of the neck, it would be far otherwise. *John Smith*,

(*a*) Elements of Juridical or Forensic Medicine.

who was executed at Tyburn on the 24th of December 1705, was cut down in consequence of the arrival of a reprieve, nearly fifteen minutes after he had been turned off, but is said to have been recovered by venesection and other means; Governor *Wall* was a long time in the act of dying, and it was subsequently discovered that this was owing to an ossified portion of the trachea resisting the pressure of the rope; but the most extraordinary instance of this kind, and one well authenticated, is that of *Margaret Dickson*, of Musselburgh, who was tried and convicted in Edinburgh in the year 1728, for the murder of her child; her conviction was accomplished by the evidence of a medical person, who deposed that *the lungs of the child swam in water*; there were, however, strong reasons to suspect the justness of the verdict, and the sequel of the story was well calculated to cherish a superstitious belief on the occasion. After execution, her body was cut down, and delivered to her friends for the rites of interment; it was accordingly placed in a coffin, and sent in a cart to be buried at her native place, but the weather being sultry, the persons who had the body in charge stopped to drink, at a village called Peppermill, about two miles from Edinburgh; while they were refreshing themselves, one of them perceived the lid of the coffin move, and uncovering it, the woman immediately sat up, and most of the spectators ran away with every sign of trepidation; a person, however, who was in the public house immediately bled her, and in about an hour she was put to bed, and by the following morning, was so far recovered

(*a*) Newgate Calendar.

as to be able to walk to her own house (*a*), after which she lived twenty-five years and had several children. (*b*)

(*a*) See *Maclaurin's Crim. Ca. p.* 71. where this circumstance is alluded to.

(*b*) By the Scottish law, in part founded on that of the Romans, a person against whom the judgment of the Court has been executed, can suffer no more in future, but is thenceforward totally exculpated; and it is likewise held, that the marriage is dissolved by the execution of the convicted party. *Margaret Dickson* then, having been convicted and executed, as above mentioned, the king's advocate could prosecute her no farther, but he filed a bill in the high court of Judiciary against the sheriff, for omitting to fulfil the law. The husband of this revived convict, however, married her publicly a few days after her resuscitation; and she strenuously denied the crime for which she had suffered.

OF THE CORONER's INQUEST.

THE office of Coroner (*Coronator*, from his duty in Pleas of the Crown, 2d Inst. 31. 4. Inst. 271) which is of great antiquity, was also of considerable dignity; (*a*) for the Coroner, together with the Sheriff, was to keep the peace of the county. He is to be elected by the full county, and for life (except in cases of misconduct, when he may be removed). The writ *De Coronatore eligendo*, F.N.B. 163, commands the Sheriff "*quod talem eligi faciat, qui melius et sciat et velit et possit officio illi intendere*, and the 3 *Edw.* 1 *c.* 10. enacts, that none but lawful and discreet knights should be chosen. But now it is held sufficient if he have enough to be made a knight (1 *Bl. Com.* 347), which is but lands to the amount of £20 per annum, (1 *Edw.* 1. *Stat. de milit*). But as the office is attended with many unpleasant duties, gentlemen, in these nicer times, have shrunk from its performance, and it has consequently fallen into disrepute; and too frequently into low and indigent hands. For though in great counties, and some populous places, it is held by very worthy and experienced men, yet in remoter parts it is to be feared that it is ill exercised; and at least, that the persons holding it have not the learning and practice necessary for its due execution. And this in all probability is an increasing evil; for an office once fallen into disrepute, and only propped by the addition of emoluments to be derived from fees (per job), generally becomes venal;

(*a*) The Lord Chief Justice of the King's Bench is the principal Coroner in the kingdom, and may, if he pleases, exercise the jurisdiction of a coroner in any part of the Realm. 4 *Rep.* 57.

and there is now too much reason to fear, that decency may be outraged by the ill-timed activity of some (*a*), as much as justice is defeated by the corruption and supineness of others, who have of late been chosen to this ancient and once honorable office. It is therefore to be wished that some legislative measure may correct or prevent this evil, by restricting the elections to persons duly qualified; and by appointing medical assessors or inspectors, who might usefully assist the Coroner in the discharge of his duties in cases of inquisition of death.

The statute *De Officio Coronatoris*, 4 *Edw.* 1 *c.* 2. directs the mode in which Inquisitions of Death shall be held. "The Coroner, when commanded by the King's bailiffs, or by honest men of the county, shall go to the places where any be slain, or suddenly dead or wounded, and shall forthwith command four of the next towns (*b*), or five or six to appear before him, in such a place; and when they are come thither, the coroner upon the oath of them shall enquire if they know where the person was slain; whether it were in any house, field, bed, town, tavern, or company, and who were there. Likewise it is to be enquired who were culpable either of the

(*a*) Except in case of persons dying in jail, the Coroner must not hold unnecessary inquests on the bodies of those who have died in the ordidary course of nature. "And the Court of King's Bench, on two several occasions within my own memory, blamed the Coroners of Norfolk and Anglesea, for holding repeated and unnecessary inquests, for the sake of enhancing their fees, on bodies and parts of bodies which were cast up by the sea shore, without the smallest probability or suspicion of the deaths happening in any other manner than by the unfortunate perils of the sea." 1 *East. P.C.* 382. See *ib.* the case of *Rex v. Harrison*, for extorting money for *not* holding an inquest.

(*b*) For this purpose the Coroner issues a precept to the constable of such townships to return a competent number of jurors, viz. not less than twelve. 2 *Hale, P.C.* 59. 62. 1 *East. P.C.* 380.

act or of the force; and who were present, either men or women, of what age, if they can speak or have any discretion. And such as are found culpable by inquisition shall be taken and delivered to the sheriff, and committed to gaol; and such as be found, and be not culpable (i.e. the witnesses, and these the coroner shall bind over by recognizance to the next assizes,) shall be attached until the coming of the justices (*a*) and their names written in the coroner's roll. If any be slain and the body found in the fields or woods; first, it is to be enquired whether he was slain in the same place or not; (*b*) and if it were brought and laid there, endeavour shall be made to follow their steps who brought the body thither; whether brought upon a horse or in a cart. Also it shall be inquired, whether the dead person were known or a stranger, and where he lay the night before. And if any be found culpable of the murder, the coroner shall immediately go into his house, and inquire what goods he has, &c. how much land, and the yearly value, and what corn on the ground, which shall be valued and delivered to the township, which shall be answerable before the justices for all; and the land shall remain in the king's hands until the lords of the fee have made fine for it, &c.

"Also it is to be enquired of those who were drowned

(*a*) But this power should be used with discretion. On a late occasion, the Judge severely reprobated the conduct of a magistrate, who had committed a poor lad to await the assizes, in company of notorious thieves and other desperate characters, because he had been the innocent witness of a felony, and was too poor to find recognizance.

(*b*) Thus in the case of Sir *Edmondsbury Godfrey*, much blood might have been spared, and much political controversy avoided, if it had been possible to determine whether the murder had taken place in the field where the body was found, or at Somerset House, as charged by witnesses who afterwards confessed their perjury.

or suddenly dead; and after it is to be seen of such bodies whether they were so drowned or slain, or strangled by the sign of a cord tied straight about their necks, or about any of their members, or upon any other hurt found upon their bodies: whereupon they shall proceed in the form above said. And if they were slain, then ought the coroners to attach the finders and all others in company.

"Upon appeal of wounds and such like, especially if the wounds be mortal, the parties appealed shall be taken immediately, and kept until it be known perfectly whether he that is hurt shall recover or not; and if he die, the offenders shall be kept: and if the party recover, the offenders shall be attached by four or six pledges after, as the wound is great or small: if it be for a maim, he shall find more than four pledges: and two pledges if it be for a small wound without mayhem. Also all wounds ought to be viewed; the length, breadth, and depth, and with what weapons, and in what part of the body the wound or hurt is, and how many wounds there be, and who gave them: all which must be enrolled by the coroner.

"Moreover if any be appealed, the party appealing of the fact shall be taken, and the party appealed of the force shall be attached also, and kept in ward, until the parties appealed of the fact be attainted or delivered.

"Also horses, boats, carts, &c. whereby any are slain, shall be valued, and delivered unto the towns as beforesaid.

"If any be suspected of the death of any man, being in danger of life, he shall be taken and imprisoned as before is said."

This statute is but in confirmation of the common

law, and therefore does not restrain the powers of the coroner which he before possessed, even though they be not mentioned in it. 1 *East. P. C.* 381, where see observations on each part of this duty.

He is to inroll the verdict of his jury, written on parchment, and return the Inquisition, either to the Justices of the next gaol delivery of the county, or certify it into the King's Bench, 2 *Roll. Abr.* 32.

He must take notes of the evidence, (*a*) and bind the witnesses to appear, for neglect of which he may be fined, 1 & 2 *Ph. & Mary*, c. 13. 1 *Lil. Abr.* 327. And if he hath not enough to answer, his fine (for this or any other offence in execution of his office), shall be levied on the county, as a punishment for electing an insufficient officer. *Mirror*, c. 1. *s.* 3. 2 *Inst.* 175.

When it happens that any person comes to an unnatural death, the township shall give notice thereof to the coroner. Otherwise if the body be interred before he come, the township shall be amerced. *Hale*

(*a*) "It is true that the statute does in terms only require the coroner to put in writing *the effect* of the evidence. But this must not be taken to give him a latitude, such as hath been but too often taken by persons of this description to the great perversion of truth and justice, of putting down, not the words of the witnesses, but his own conception of their tendency. It is doubtless the meaning of the act, that the examination of the witnesses should be taken down with the greatest possible accuracy as to all material points of the inquiry: otherwise one great benefit of the act, which is to enable the Court to compare the examination with the evidence, must be defeated. *The effect* mentioned therein, means the true and genuine sense of the evidence, as delivered in detail, not indeed in letters, syllables, or even words; though these should not be needlessly departed from; but the fair and obvious meaning of the words spoken, and not the final result of the evidence. Complaints have in my own memory been made by judges on the circuits of the culpable neglect of coroners in this respect, and threats of exemplary punishment holden out to them, to prevent a repetition of the same abuse in future." 1 *East. P.C.* 384.

P.C. 170. And *Holt*, C.J. says, It is a matter indictable to bury a man that dies a violent death, before the Coroner' Inquest have sat upon him. 2 *Hawk. P.C. n.* 8. 1 *Burn's Just.* 562.

Though it is not necessary that the inquisition be taken in the place where the body was viewed, 2 *Hawk. P.C. c.* 9. *s.* 25. yet he has no authority to take an Inquisition of Death, without a view of the body, and if an inquest be taken by him without such view, it is void. 2 *Lev.* 140 (*a*). But after the view, which must be by the jury and coroner together, the inquest may adjourn to a more convenient place. (*b*)

He may in convenient time take up a dead body that hath been buried, in order to view it: but if it be buried so long that he can discover nothing, or if there be danger of infection, the inquest ought not to be taken by the coroner, but by Justices of Peace, by the testimony of witnesses; for none can take it on view, but the coroner. *Bro. Coron.* 167. 173. If the body is improperly buried, or suffered to lie

(*a*) It must be on the actual view of the body, the coroner and his party seeing it together. 2 *Hale* 60. 1 *East.* 380. *King v. Ferrand.* 2 *Barn. & Ald.* 260.

It was evidently the original intention of the Legislature, that the coroner should view the body on the spot where it was found; that he and his jury might judge as well by inspection of the body, as by an examination of surrounding objects, whether the deceased had died by violence. And Sir *William Blackstone* says, "He must also sit at the *very* place where the death happened," 1 *Com.* 348. and this should certainly be done in all possible cases, for the state of surrounding objects most frequently will testify more strongly than any other evidence. Modern fastidiousness has introduced the custom of removing the body to some public-house, even where the death had happened in an ordinary dwelling; this if not illegal, is at least improper.

(*b*) See also the proceedings on the Oldham inquest, and the subsequent judgment in the Court of King's Bench. *A.D.* 1818, 1819. The *King against Ferrand*, 2 *Barn & Ald.* 260.

till it stinks, the town shall be amerced. 2 *Danv. Ab.* 209. *Hale, P.C.* 270. 2 *Hawk.* 48.

A Coroner's Inquisition being final, the coroner ought to hear counsel(*a*) and evidence on both sides.(*b*) 2 *Sid.* 90. 101. He must admit evidence as well against the king's interest as for it; and for omitting to do so, his inquisition may be quashed. 2 *Hale, P.C.* 60. (*c*) 1 *East's P.C.* 383.

The coroner among other things must enquire of the deodand, which on the violent death of any one, even though purely accidental, has accrued to the king or his grantee.

This mulct was, in ancient times, applied to the purpose of purchasing masses, for the repose of the soul of the deceased; it is now converted into an ill apportioned, arbitrary, or, in a few cases, inadequate fine (*d*) on the individual, whose property has been,

(*a*) This was publicly disputed on a late occasion; it is well to question all extra-judicial dicta, which may be delivered during the heat of political controversy.

(*b*) The evidence must be on oath; *vide ante p.* 167.

(*c*) In *Scorey's* case, *Leach C.L.* 50. the coroner refused to take the evidence of a man who had accompanied the accused in search of deer-stealers, and only admitted the man who was with the deceased. The coroner, on the testimony of this man, told the jury, that the crime was murder, but they refused to find any other verdict than *Accidental death*; which verdict the coroner recorded, and then by his warrant sent *Scorey* to the county goal for murder.

Scorey being now brought up by Habeas Corpus—The Court, on full affidavit of the fact, admitted him to bail, and granted a rule against the coroner to shew cause why an information should not be filed against him.

(*d*) There are many cases in which there is no substance which can be made the subject of deodand; as in death by poison or by explosions in mines, either from inflammable gas, or the powder used in blasting. The first of these cases calls for immediate remedy; as the instances of fatal substitution of poison for medicine occur continually, notwithstanding the repeated warnings published on the subject. Nor are

whether innocently or culpably, the cause of death. It is as absurd that a ship under sail, from which a man has fallen and been drowned, should be forfeited to the king; as it is lamentable that the ignorant, and too frequently the criminally negligent vender of oxalic acid for Epsom salts, should escape all punishment.

Where a thing is not in motion, that part of it which actually caused the death is alone forfeited, "as if a man be climbing on the wheel of a cart, and is killed by falling from it, the wheel alone is a deodand. I *Bl. Com.* 300. But whenever the thing is in motion, not only that part which immediately gives the wound, (as the wheel which runs over his body) but all the things which move with it, and help to make the wound more dangerous (as the cart and loading, which increase the pressure of the wheel) are forfeited." *ibid.* The utmost penalty of this law might often be inflicted on the proprietors of stage coaches, where the wilful negligence, drunkenness, or brutality of the driver had occasioned the loss of life. "It matters not whether the owner were concerned in the killing or not; for, if a man kill another with my sword, the sword is forfeited." *ibid.* The learned Commentator thus concludes, "But juries have of late very frequently taken upon themselves to miti-

accidents in mines less worthy of attention; ordinary precaution might have prevented many which have lately taken place. The Safety lamp of Sir *H. Davy* is so firmly established in reputation, that no doubts can be entertained of its efficacy; some late inventions also have secured the miner from the numerous disasters to which he is liable in the dangerous operation of blasting. When the conductors of mines neglect these ordinary and well-known precautions, they become morally responsible for any mischief which may consequently occur; we have only to lament that they are not legally answerable for their criminal neglect.

gate these forfeitures, by finding only some trifling thing, or part of an entire thing, to have been the occasion of the death. And in such cases, although the finding of the jury be hardly warrantable by law, the Court of King's Bench hath generally refused to interfere on behalf of the lord of the franchise, to assist so unequitable a claim." 1 *Com.* 301. Thus is the justice of the country injured, in order to restrain the rapacity of individuals, improperly invested with the prerogatives of the crown. See also 1 *East. P.C.* 386.

A coroner may be punished for misconduct by fine, imprisonment, or removal; as if he be remiss in coming to do his office when he is sent for, he shall be removed by virtue of the statute *De Coronatoribus* 4 *Ed.* 1. *c.* 2: *Salk.* 37. *Hale P.C.* 170. or if he do not properly execute his office. 1 *Lill. Abr.* 327.

If his Inquisition be quashed, and a *melius Inquirendum* is granted, that Inquisition must be taken by the Sheriffs or Commissioners, upon affidavits. (*a*) 1 *Danv. Abr.* 210. *Salk.* 190.

The filing of a coroner's inquest may also be stopped for mismanagement. 1 *Mod.* 82. If he conceal felonies he shall be fined, and suffer one year's imprisonment. 3 *Ed.* 1 *c.* 9. In Lord *Buckhurst's* case a coroner not returning his inquisition of murder to the next gaol delivery, but suppressing it, was discharged from his office, and fined £100. 1 *Kebl.* 280.

If a coroner be convicted of extortion, wilful ne-

(*a*) With respect to a second inquest, the law is thus laid down (3 *Barn.* & *Ald.* 266.) So also he (the coroner) may dig up the body, if the first Inquisition be quashed. *Str.* 533. But it must be by order of the Court of King's Bench, on motion, *Str.* 167. And the judges will exercise their discretion, according to the *time* and circumstances, whether he shall or shall not do it. *Salk.* 377. *Str.* 22. 533. 2 *Mod.* 16.

glect of duty, or misdemeanor in his office, the Court before whom he shall be convicted, may adjudge that he shall be removed from his office. 25 *Geo. 2. c. 29.*

And lastly, by the writ *De Coronatore exonerando*, *F.N.B.* 163. 164: he may be discharged for negligence, or insufficiency, in the discharge of his duty, and when coroners are so far engaged in any other public business that they cannot attend the office; or if they be disabled by old age or disease, or have not sufficient lands, or live in an inconvenient part of the county. *2 Inst. 32. 2 Hawk. P.C. c. 9. s. 12.* But if any such writ be obtained on an untrue suggestion, the coroner may procure a commission out of Chancery to enquire thereof; and the king may grant a supercedeas of the writ. *Reg. Orig.* 177. 178. *F.N.B.* 164. As the coroner's is an office of freehold, the Court of Chancery will not suffer the writ to issue, unless on affidavit that the defendant has been served with notice of the petition for it. *3 Atk.* 184. On the election of a new coroner the office of the old one is *ipso facto* extinguished.

We have entered more fully into this description of the office and duties of coroner in general, as we deem the due execution of them to be of the utmost importance to the public welfare; not indeed intending it as a guide to coroners themselves, for to that purpose it would be insufficient; but to give some insight into the nature and character of the office, to those who may, from time to time, be called upon to aid its administration. It is however necessary for us to add that there are some exceptions to the above mentioned rules, arising out of local customs and peculiar jurisdictions; thus the Lord Mayor of London is by virtue of his office, coroner within the City, and the Court is holden

before him or his deputy. 4 *Inst.* 250. And other places, as some of the Royal residences, &c. have their separate coroners; but all, whatever the mode of election or appointment, are in cases of misconduct subject to the jurisdiction of the Court of King's Bench.

SUICIDE.

SELF-MURDER is ranked among the higher crimes, being a peculiar species of felony, as implied in the technical term *felo de se.* To constitute this offence, the party must be in his senses, else it is no crime; but this excuse ought not to be strained to that length to which our coroner's juries are too apt to carry it, (*a*) viz. that the very act of suicide is an evidence of insanity; as if every man who acts contrary to reason, had no reason at all; for the same argument would prove every other cri-

(*a*) It is not for us in this place to argue the question whether excessive severity of punishment does or does not defeat its punishment; as more injury is done by inducing that illegal mercy which is here complained of, than benefit is derived by terror of the unexecuted sentence of the law: the subject is in abler hands; we shall, therefore, content ourselves with suggesting, that coroners should be far more strict in their examination of the bodies of persons supposed to be *felo de se;* nay, that anatomical inspection of the great cavities should be absolutely required in all cases. We will not maintain with a French author on Medical Jurisprudence, that the signs of insanity can often be discovered on dissection; though we can imagine some cases, as where there has been an excessive determination of blood to the brain, in which this inspection may be satisfactory; (See vol. I, p. 327). *Fourcroy* and *Durande* have also found, on dissecting persons who had committed suicide, hardness of the liver, and gall stones; and *Foderé* observes that, in failure of other evidence, such appearances deserve to carry some weight. But benefit would still result from the practice; first from the general horror in which dissection is held, for if the dread of an ignominious burial, however remote the chance of its infliction, can be supposed to discourage this offence, under the existing law, the certainty of personal mutilation would operate in the proposed alteration. It is related, that when suicide had become so frequent among the Roman ladies, as to threaten ill effects to the commonwealth, the Senate decreed that the bodies of all who died by their own hands should be exposed naked in the public ways.

The effect of the decree was an immediate cessation of the crime; possibly the same result might be produced by the dread of dissection.

minal *non compos*, as well as the self-murderer. The law very rationally judges, that every melancholy or hypochondriac fit does not deprive a man of the capacity of discerning right from wrong; and, therefore, if a real lunatic kills himself in a lucid interval, he is *felo de se* as much as another man. 1 *Hales, P. C.* 412. 1 *Hawk. P. C. c.* 27, *s.* 3.

As to the punishment which human laws inflict on this crime, they can only act upon what the criminal has left behind him,—his reputation and fortune; on the former, by an ignominious burial in the highway, with a stake driven through his body; on the latter, by the forfeiture of all his goods and chattels to the king.

In this as well as all other felonies, the offender must be of the age of discretion, and *compos mentis;* and therefore an infant killing himself, under the age of discretion, (of which some extraordinary instances have lately been related in the public journals) or a lunatic during his lunacy, cannot be a *felo de se.* 1 *Hawk. P. C. c.* 27, *s.* 1. *Crom.* 30, *a* 6, 31; *Hales P. C.* 28; *Dalt. c.* 92; 3 *Inst.* 54.

He who kills another, though at his own desire or command, is a murderer; (*a*) and the person killed is not looked upon as a *felo de se*, in as much as his

(*a*) Al sessions al Newgate post natalem dom. 1604, 2 *Jac.* Le case fuit que en home et se feme ayant longe temps vive incontinent ensemble, le homme ayant consume son substance et cressant en necessity, dit al feme que il fuit weary de son vie, et qu'il voiloit luy m occider, a que la feme dit que donques el voiloit auci moryer ove luy: per que le home praya la feme que el voiluit vaar et acheter ratisbane, et ils voilont ceo beber ensemble, le quel el fist, et el ceo mist en le drink, et ils bibe ceo, mes la feme apres prist sallet oyle, per que el vomit et fuit recover, mes le home morust: et le question fuit si ceo fuit murther en la feme. *Montague* recorder cause l'especial matter d'estre trove: *quære* le resolucion. *F. Moore*, 754.

assent was merely void, being against the law of God and man; 1 *Hawk. P. C. c.* 27, *s.* 6; *Keilw.* 136; *Moor* 754. But query, as he is the guilty cause of his own death, is he not a felon? for if the question had been of the death of another, his consent to it would have been equally against the laws of God and man; yet if poison were given by his direction or command, even though he were not present, and might have repented, it would be murder, much more then, when he actually assists at the perpetration.

Further, as to what a *felo de se* shall forfeit, it seems clear that he shall forfeit all chattels, real or personal, which he hath in his own right; and also all chattels real, whereof he is possessed jointly with his wife, or in her right; and also all bonds and other personal things in action, belonging solely to himself; and also all personal things in action, and as some say, entire chattels in possession, to which he was entitled jointly with another, on any account, except that of merchandize. But it is said, that he shall forfeit a moiety only of such joint chattels as may be severed, and nothing at all of what he was possessed of as executor or administrator; 1 *Hawk. P. C. c.* 27, *s.* 7, and authorities there. However the blood of a *felo de se* is not corrupted, nor his lands of inheritance forfeited, nor his wife barred of her dower. 1 *Hawk. P. C. c.* 27, *s.* 1; *Plowd. Com.* 261 b, 262 a; 1 *Hales, P. C.* 413. The will of a *felo de se* becomes void as to his personal property, but not as to his real estate. *Plowd.* 261.

Not any part of the personal estate is vested in the king, before the self-murder is found by some inquisition; and consequently the forfeiture thereof is saved by a pardon of the offence before such finding; 5 *Co. R.* 110 b; 3 *Inst.* 54; 1 *Saund.* 362; 1 *Sid.* 150,

162. But if there be no such pardon, the whole is forfeited immediately after such inquisition, from the time of the act done, by which the death was caused; and all intermediate alienations and titles are avoided. *Plowd. Comm.* 260; *Hales P. C.* 29; 5 *Co. R.* 110; *Finch.* 216. All such inquisitions ought to be by the coroner *super visum corporis*, if the body can be found; and an inquisition so taken cannot, as some say, be traversed. *Hale, P. C.* 29; 3 *Inst.* 55; 1 *Hawk. P. C. c.* 27, *s.* 9, 10, 11. But see also 3 *Mod.* 238, 1 *Burr.* 17.

But if the body cannot be found, so that the coroner, who has authority only *super visum corporis*, (vide ante. p. 93), cannot proceed, the inquiry may be by Justices of the Peace, (who by their commissions have a general power to inquire of all felonies,) or in the King's Bench, if the felony were committed in the county where the court sits; and such inquisitions are traversable by the executor, &c. 1 *Hawk. P. C. c.* 27, *s.* 12; 3 *Inst.* 55; *Hales P. C.* 29; 2 *Lev.* 141.

Also all inquisitions of this offence being in the nature of indictments, ought particularly and certainly to set forth the circumstances of the fact; and in conclusion add, that the party in such manner murdered himself. 1 *Hawk. P. C. c.* 27, *s.* 13; 3 *Lev.* 140; 3 *Mod.* 100; 2 *Lev.* 152. Yet if it be full in substance, the coroner may be served with a rule to amend a defect in form. 1 *Sid.* 225, 259; 3 *Mod.* 101; 1 *Keb.* 907; 1 *Hawk. P. C. c.* 27, *s.* 15.

If a person is unduly found *felo de se;* or on the other hand found to be a lunatic, when in fact he was not so, and therefore ought to have been found *felo de se*; although a writ of *melius inquirendum* will not be granted, yet the inquisition is traversable in the King's Bench. 3 *Mod.* 238.

By the rubrick in the Common Prayer, before the burial office, (confirmed by *Statute* 13 and 14, *Car.* 2, c. 4) persons who have laid violent hands on themselves shall not have that office used at their interment. Yet the priest has no power of enquiry, or even as it would appear of delay, in order to enquiry, when a body (though it be of a notorious suicide) is brought to his church for interment. "The "proper judges, whether persons who died by their "own hands were out of their senses" (and a fortiori whether they did or not die by their own hands) "are doubtless the coroner's jury. The minister of "the parish hath no authority to be present at viewing the body, or to summon or examine witnesses, "and therefore he is neither entitled nor able to judge "in the affair; but may well acquiesce in the public "determination, without making any private enquiry. Indeed, were he to make one, the opinion "which he might form from thence could usually be "grounded only on common discourse, and bare "assertion. And it cannot be justifiable to act upon "these in contradiction to the decision of a jury, "after hearing witnesses upon oath. And though "there may be reason to suppose that the coroner's "jury are frequently favourable in their judgment in "consideration of the circumstances of the deceased's "family with respect to the forfeiture, and their "verdict is (*a*) in its own nature traversable, yet the "burial may not be delayed, (*b*) until that matter on

(*a*) Vide ante, tit Coroner's Inquest.

(*b*) Decency and public policy require that burials should not be delayed, and it may not be amiss here to observe that the old notion of arresting a body for debt, is now utterly exploded, as contrary not only to the civil and canon law, (see *Wood's Civ. Law*, 143; 2 *Domat* 628: *Lindw.* 278,) but to reason and the law of the land. Vide ante, Vol. 1. p. 100.

" trial shall finally be determined. But on acquittal " of the crime of self-murder by the coroner's jury, " the body in that case not being demanded by the " law, it seemeth that a clergyman may and ought" (we can safely add is compellable) " to admit that " body to christian burial." 1 *Burn's Ecc. Law, tit. Burial.*

OF MURDER GENERALLY.

THERE are so many various modes by which this infamous and horrid crime may be perpetrated, that it would be an almost endless task to enumerate them. In a legal point of view it is scarely necessary; for wherever death ensues from illegal violence (*a*), with malice *prepense*, it is felony; yet for the better aid of medical investigation it is expedient to class them under several heads.

Sir *Matthew Hale*, in his pleas of the Crown, vol. 2, p. 431, enumerates several ways of killing.

1. By exposing a sick or weak person or infant unto the cold, to the intent to destroy him, 2 *Ed.* 3, 189, whereof he dieth.

2. By laying an impotent person abroad, so that he may be exposed to and receive mortal harm, as laying an infant in an orchard, and covering it with leaves, whereby a kite strikes it and kills it. 6 *Eliz.*

(*a*) It is said that to act upon the mind by terror, continual griefs or vexations, though with the intent to kill, is not murder, unless there be some personal violence, 1 *East. P. C., p.* 225: but query this, the proof of the crime may be difficult, but its perpetration is far from impossible. To act on the mind of a pregnant woman by extreme terrors, and so produce abortion and death of malice prepense, would certainly be murder in its most atrocious form; it might require some ingenuity in framing the indictment; but our law is fertile in fictions on less worthy occasions, and ought not to allow its just vengeance to be avoided. In cases of murder by starvation there may be no actual violence, yet the law reaches this offence; sometimes indeed imprisonment forms a part of the crime, but this may not always be the case; for if the deceased were confined to his bed by disease, so that he could not seek his own food, and those who were bound to supply him maliciously neglected their duty, it would be murder by omission without any personal violence committed. *See Self's* case, 1 *East. P.C.* 226: 1 *Leach, C.C.* 163, and authorities there. So in an indictment for starving a servant, *Lawrence*, J. intimated, that he thought the indictment insufficient, in not alleging *that Elizabeth Williams was a girl of tender years, and under the dominion and controul of the defendant. Rex v. Eliz. Ridley*, 2 *Camp. R.* 650. See also *Regina v. Gould. Salk.* 381.

Compt. de Pace; 24 *Dalton, cap.* 93, (new edit. 145.) (*a*)

3. By imprisoning a man so strictly that he dies, and therefore where any dies in gaol, the coroner ought to be sent for to enquire of the manner of his death.

4. By starving or famine.

5. By wounding or blows.

6. By poisoning.

7. By laying noisome and poisonous filth at a man's door, to the intent by a poisonous air to poison him. *Mr. Dalton, cap.* 93, out of *Mr. Cook's* reading. (*b*)

8. By strangulation or suffocation.

"*Moriendi mille figuræ.*"

The two first of these modes frequently occur in cases of infanticide, and to that head, which requires separate consideration on account of its intricacy, we shall therefore refer it. Adults can seldom, if ever, be exposed to destruction in this manner; though, as in —— *Brownrigg's* case, and others of the same class, it may constitute a part of the crime of murdering children, even of an advanced age, by duress and starvation; where it is by a combination of cruel

(*a*) "Such also was the case of the parish officers who shifted a child from parish to parish, till it died for want of care and sustinence." 1 *East. P. C.* 226, and authorities there. Unfortunately this species of crime is not of very rare occurrence; numerous instances might be cited where the death of a pauper has been caused by the barbarous custom of removing the poor, without the slightest regard to their age, disease, or infirmity.

(*b*) As we are not aware of the existence of any poisonous filth so noxious as to destroy by its mere stench, we shall not enlarge on this head; we have indeed heard of an attempt to kill by the smoke of burning Euphorbium, but without believing in its power. *Vide ante tit. Nuisance, et post, Aerial poisons.*

injuries, and not by one specific blow or wound, that death is produced. These cases we shall include under a general head, having first disposed of those which require more specific notice.

> "*By imprisoning a man so strictly that he dies, and therefore where any dies in gaol* (*a*) *the coroner ought to be sent for to enquire of the manner of his death.*"(*b*)

Death by duress of imprisonment was in all probability a very frequent occurrence in the earlier periods of our history, we know that it has often been inflicted by the individual tyranny of the nobles on their vassals; and we have every reason to suppose, that even the keepers of our public prisons were not free from the imputation of cruelty to their unfortunate inmates; many have died by violence, more by neglect; it was therefore a wise and humane precaution that the circumstances of every death of a prisoner should be made the subject of minute enquiry; it is also desirable that such enquiry should be carried on by persons of competent skill, and with every possible and proper publicity. Our own times we will hope are entirely free from the crime of premeditated murder on the body of a prisoner; but we must not allow our confidence in the modern improvements of prison discipline to lull us into a false security as to the conduct of gaolers and their underlings

(*a*) In this case it is not necessary that there should be any signs or even suspicion of violence; the bare fact that they died in gaol is enough.

(*b*) One half of the jury should be of the prisoners, 1 *East P. C.* 383, for they are most likely to know if any unnecessary hardship had been inflicted on the deceased.

many of these may be men of mild and humane disposition, but as their daily occupation must tend to blunt the finer feelings of humanity, it is well that every charge of misconduct should be met by immediate and rigorous enquiry. On this subject see *Rex* v. *Huggins*, warden of the Fleet, 2 *Lord Raym.* 1578; 2 *Str.* 882; 9 *Harg. St. Tri.* 107; *Bambridge's* case, 9 *Harg. St. Tri.* 146, 151; *Acton's* case, 9 *Harg. St Tri.* 182, 210, 218; see also the several Parliamentary Reports on Coldbath-fields, Ilchester, &c.

" A gaoler, knowing a prisoner to be infected with an epidemic (*a*) distemper, confines another prisoner against his will, in the same room with him, by which he catches the infection, of which the gaoler had notice, and the prisoner dies; this is a felonious killing. *Stra.* 856; 9 *St. Tri.* 146. So, to confine a prisoner in a low damp unwholesome room, not allowing him the common conveniences which the decencies of nature require, by which the habits of his constitution are so affected as to produce a distemper of which he dies; this also is felonious homicide. *Stra.* 884; *Lord Raym.* 1578. For although the law invests gaolers with all necessary powers for the interest of the commonwealth, they are not to behave with the least degree of wanton cruelty to their prisoners. *O. B.* 1784, p. 1177; and these were deliberate acts of cruelty, and enormous violations of the trust the law reposeth in its ministers of justice. *Forster*, 322." See I *Hawk.* P. C. by *Leach*, p. 119.

Previous to the researches of the celebrated *John Howard*, (see his treatise on Prisons and Lazarettos)

(*a*) The learned Reporter does not appear to have adverted to the distinction between epidemic and contagious distempers. See vol. 1, p. 105.

our prisons appear to have been in a most disgraceful state; they are now greatly improved, but something may yet be done for their amelioration, more particularly as affecting the health of the prisoners; and this principally, by allowing the most unrestrained medical inspection by disinterested practitioners, who should be as much as possible unconnected with local prejudices, or partialities; some of the parliamentary regulations of madhouses might in this respect be usefully extended to all places of confinement; those who are not *sui juris* are ever entitled to additional protection. *(a)*

The best practical proof of improvement, in the construction of our prisons, and in our prison disci-

(a) It is to be feared that grand juries will discontinue their salutary custom of visiting the prisons, in consequence of a recent decision that they have no right to demand admission. As the propriety of their inspection is generally granted, we may venture to hint a wish that some enactment may pass on this subject, and that the temporary political objection, arising out of the seclusion of state prisoners, may not be permitted to operate as a general and permanent obstacle. It is to the zeal of individuals in tracing abuses, rather than to legislative enactment for their prevention, that we look for the still necessary improvements of our prison discipline; for no government, however vigilant, can guard against the secret misconduct of its obscurer agents; all it can do, is to encourage enquiry, whenever the first hint of delinquency or even of suspicion is communicated. The subject is now under legislative consideration, and we may therefore hope that a due system may be adopted, one which shall equally steer clear of the wasteful expenditure of the Millbank Penitentiary, and the enormities imputed to Ilchester: that prisons may be made places of confinement, coercion, and punishment; but not of torture, contagion, and despair.

The improvement in morals, order, and cleanliness introduced into some prisons by the exertions of a benevolent individual *(Mrs. Fry)* deserves our notice; her attention indeed has been mainly directed to the mental and religious instruction of female prisoners, but this mental improvement is not without its effect on their bodily health; order, temperance, and cleanliness, will always produce a physical as well as moral improvement on the minds and persons of the lower orders.

pline, is to be found in the disappearance of that fatal pest, which was commonly called the gaol fever, a disorder which, with something of retributive justice, frequently extended its ravages to those, whose proper vigilance might have prevented its generation. At the assizes held at Oxford in 1577, (*a*) called the black assize, we learn from *Baker's* Chronicle (p. 353) that all who were present died within forty hours: the Lord Chief Baron, the Sheriff, and about three hundred more. *Lord Bacon* ascribed the fatality to a disease brought into court by the prisoners, and *Dr. Mead* entertained the same opinion; nor was similar infection, though to a less extent, an uncommon occurrence (*b*), see vol. 1, p. 125. The ancient practice of strewing the court with aromatic herbs and flowers, and presenting bouquets to the Judges, is said to have derived its origin from the idea of preventing infection: fresh air, still wanting in our courts, would have proved a more powerful, and not less agreeable prophylaitic.

(*a*) A similar calamity occurred in Dublin in 1776, when the sheriff, several counsellors, and others, fell victims to this disease. Gents. Mag. The death of the late Judge *Osborne* also is attributed to an ill-ventilated court.

(*b*) The law does not appear to have made any sufficient provision for the (not improbable) contingency of a highly infectious disorder breaking out in any prison, yet it is evidently unjust that a prisoner for a debt of *one shilling!* or any other sum, should be exposed to the hazard of his life by remaining in contact with the infected, (see *Buxton's* Inquiry.) Formerly the writ of *Habeas Corpus* was granted on such occasions, but abuses having arisen it was ultimately referred to the judges to consider the legality of this application of the writ, who decided against it; adding, however, that in case of great infection some house in some good town might be assigned for the warden of the Fleet, and the like for the marshal of the King's Bench, where they might keep their prisoners *sub arcta et salva custodia. Hutt.* 129. But query, how far this course would be applicable to other prisons?

BY WOUNDING, OR BLOWS.

In investigating the subject of Wounds, it will be convenient to adopt, on the present occasion, the usual classification of local injuries, viz. 1. *Incised wounds*, or cuts; 2. *Punctures*, or such as are inflicted by pointed instruments; 3. *Bruises*, injuries occasioned by blunt instruments; 4. *Lacerations*, where the integuments are torn, and 5. *Gun-shot wounds*; upon each of which we shall offer a few observations, and, in the first place, it may be remarked generally, that no graduated scale of wounds, expressive of the degree in which they are curable or dangerous, can ever be constructed; in appreciating the probable degree of danger that attends a wound other data will be required for the solution of the problem than those deduced from situation and extent, such as the constitution and temperament, age, habits of life, especially as they regard temperance and sobriety, previous state of health, unnatural structure and disposition of parts, and existing diseases of the wounded individual; together with the temperature of the season, and other extrinsic circumstances. As a general rule for our guidance a division of wounds into four classes has been suggested, viz. 1. *Absolutely mortal.* 2. *Dangerous.* 8. *Accidentally mortal.* 4. *Not mortal.* Every practitioner, however, must be aware that death will occasionally supervene on the slightest injury, and at other times that the patient recovers in spite of the most serious and extensive mischief; in proof of the former assertion, the author may state that he has seen a case in which the extraction of a tooth was followed by death in less than forty-eight hours; and every experienced surgeon must in the course of his practice have observed the

slightest wound (*a*) productive of alarming and even fatal consequences; in illustration of the occasional occurrence of a contrary result we may recal to the recollection of the reader the extraordinary case (*b*) of Mr. *Thomas Tipple*, who recovered after an accident, by which the shaft of a chaise had been forced through the thorax! There have also been instances of the recovery of persons whose brain has been wounded to a considerable depth, of others shot through the head; Dr. *Male* states that a pauper in Paris, some years ago, used to receive charity in a piece of his skull. In the second volume of the *Medico-chirurgical Transactions*, we have a well attested case of a bayonet wound in the heart not causing immediate death. *Littre* has given us a report of a man who inflicted upon himself no less than eighteen stabs in the abdomen with a knife; and although some of them did not penetrate beyond the parieties, yet others wounded the contents; the symptoms which followed are stated to have been very severe, but by judicious treatment the patient recovered; seventeen months afterwards, however, he threw himself into the street from a three pair of stairs window, and was instantly killed. On examining the body all the wounds were found healed, and, with the exception of one, all the cicatrices were firm and level; they were traced into the intestines, where corresponding adhesions were observed. (*c*)

The surgical practitioner will, after such cases, be cautious in his prognosis, and profit by the experience

(*a*) The learned *Jacob Bryant* lost his life from mortification in his leg, originating in the slight circumstance of a rasure against a chair, in the act of reaching a book from a shelf.

(*b*) See "An account of a case of recovery, after an extraordinary accident, by which the shaft of a chaise had been forced through the thorax." By William Maiden; London, 1812.

(*c*) Memoires de l'Acad. Royale. 1705.

of Hoffman, who says, "*In judicio de vulnerum letha-*
"*litate ferendo multorum Medicorum fama et fortuna*
"*periclitantur.*"(*a*) Fortunately for the administration of justice, that act of the Legislature, called "*the Ellenborough act,*" relieves us from many of those embarrassments under which the professional witness (*b*) must otherwise have laboured, and the surgeon will appreciate the high importance and utility of the law, by which wounding with an intent to kill is deemed equally criminal, whether death be the result or not. Still, however, the testimony of the medical practitioner will always be important; indeed the evil intent is often to be inferred, or disproved, by the nature of the injury inflicted; as is so well illustrated in the case of a man, who fractured the skull of a boy with a stick, upon finding him in the act of plundering his orchard; when it was clearly made out in evidence, that a mere chastisement was only intended, for the size of the stick was not such as to have occasioned any fatal effect, had not the skull of the unfortunate boy been unusually thin.

If the surgeon is called upon to inspect a wound, with a view to ascertain whether it produced death, he should in the first instance, endeavour to examine its nature and direction, so as to disturb as little as possible the position in which the body was found; the knife of the anatomist must afterwards explore its more particular condition and relations, by a dissection, for the performance of which we shall give ample directions in a future chapter.

(*a*) Med. Polit. P. 1. C. 1.

(*b*) *Hebenstreit* observes that if a man is wounded by two different persons, one of whom stabs in the side, the other in the belly, it becomes necessary after death to ascertain of which wound the deceased died, in order that the actual murderer may be punished. By the law of England this question can never arise.

The importance of examining the wound, so as not to alter the position of the parts must be obvious when we consider how necessary it may afterwards become to compare as strictly as possible the internal appearances with the external lesions. The direction of a wound is frequently a circumstance of much greater importance than may at first appear, we ought not therefore to probe it without extreme caution, lest we should give to it a direction which it did not originally possess. This precaution becomes the more necessary as the putrefactive process advances.

Of incised wounds, or cuts. The prognosis of wounds made with a cutting instrument varies, *cæteris paribus*, according to the extent and depth of the division, the nature of the injured parts, and the circumstances which attend the operation; where the instrument has been so sharp as not to occasion any contusion or laceration, the fibres and texture of the wounded part will have suffered no other injury but their mere division; and there is consequently less tendency to inflammation, suppuration, gangrene, and other bad consequences; if the wound be large and deep it will be more dangerous, as well as more difficult to heal, than one which only affects the skin. Wounds, accompanied with injury of considerable vessels or nerves, are more or less hazardous, according to the magnitude or number of those vessels or nerves; generally speaking, the most dangerous examples of incised wounds are those which are made about the throat; here there are so many large blood-vessels, nerves and other parts of great importance, that deep incised wounds often prove fatal, either immediately, or in a few days; in some cases of suicide the carotid artery is opened, and the person perishes from hemorrhage on the spot, before any assistance can be

afforded; in other instances he divides some of the principal branches of the external carotid, and after losing a great deal of blood, he faints, and the hemorrhage being thus checked, the life of the patient is preserved, until surgical assistance can be procured. Cut wounds of the extremities, when such arteries as the femoral and brachial are injured, may also suddenly destroy the patient, by hemorrhage. (*a*)

Punctures, or such as are made by the thrust of pointed weapons, as by swords, daggers, lances, and bayonets, or by the accidental and forcible introduction of considerable thorns, large nails, skewers, &c. into the flesh, (*b*) comprise a class of wounds of great importance and danger, as they generally penetrate to a great depth, so as to injure large blood-vessels, nerves, viscera, and other organs of importance; and being inflicted with considerable violence the parts always suffer more injury than what would be produced by their simple division. It must also be considered, that a great number of the weapons by which such wounds are occasioned, increase materially in diameter from the point towards their other extremity; and hence, when they penetrate far, they must force the fibres asunder like a wedge, and cause a serious degree of stretching and contusion. It is this circumstance which gives so dangerous a character to bayonet wounds in the soft parts. The opening which the point of such a weapon produces is quite insufficient for the passage of the thicker part of it, which can therefore only enter by forcibly dilating, stretching, and otherwise injuring the fibres of the wounded flesh. But mortal injury may be inflicted by an extremely slender instrument, so as to occasion an ap-

(*b*) The bites of venomous animals will be considered under the head of Poisons.

parently trivial puncture; and in some cases, the external injury is healed before the death, which it occasions, takes place. Such cases can only receive satisfactory elucidation from the lights of an anatomical dissection, under which head we have furnished several instructive examples.

Bruises, or *Contusions*, strictly comprehend those injuries which are occasioned by the violent application of blunt or obtuse instruments to the soft parts. They are not unfrequently complicated with severe internal injury resulting from the violence which the parts have sustained, such as inflammation, suppuration, or even the rupture of some of the viscera, of which we shall hereafter present several illustrative cases.

A blow on the region of the stomach sometimes occasions instant death; an effect which would appear to arise from an injury inflicted upon the eighth pair, and great sympathetic nerves, by which the heart is instantly paralysed. In these cases the heart has been found empty, and the stomach has appeared red and inflamed; this latter appearance is the obvious effect of the sudden cessation of the heart, producing the settling of the blood in the extreme arterial branches.

Wounds of this description are, of course, more or less important, according to their locality; unless complicated with laceration, they are never attended with any considerable hemorrhage, although the minute vessels are necessarily ruptured, and the effusion of their contents produces the discoloration so characteristic of this kind of injury.

As in the case of wounds, so also in respect of blows, injuries apparently inadequate have produced death; it then becomes difficult to fix the degree of guilt which should be attached to the aggressor; for though

according to the strict letter of the law, every man is responsible for the ultimate effect of an illegal act committed by him; yet in moral justice there is much difference between the atrocity of him who strikes a grievous wound with a deadly weapon, from which by chance his victim may recover; and the fault of him who transported by sudden passion gives an ordinary blow, which by accident, by reason of some inward and unknown disease of his adversary, or by injudicious treatment, becomes fatal. Numerous cases might be cited in support of this position: that of *Brain* for the murder of *Watts*, *Cro. Eliz.* 778: *H. P. C.* 455. is one of the most remarkable, not only from the circumstances attending the trial, where the jury were fined and imprisoned for a corrupt verdict, but also for the physiological circumstance, that the deceased died instantly from a blow on the calf of his leg. The parties had previously quarrelled and fought; and *Brain*, the prisoner, was hurt; the next day *Watts* passing his shop made mouths at him, on which new provocation *Brain* hit him the blow which instantly proved fatal. The Court held that the new provocation was insufficient, and that the death must be referred to precedent malice—might they not also have considered that a blow on the calf of the leg was more insufficient to produce death under ordinary circumstances, than a wry face to induce or inflame a quarrel? The prisoner was found guilty, but not without considerable and as it appears to us proper resistance on the part of the jury; the case being on Appeal, the Crown could not pardon, though the appellant might compromise his suit:—we are not informed whether the prisoner was executed.

A case, nearly parallel to the above, is that of *Lydia Alder*, who was tried in 1744 for the murder

of her husband, whom she kicked on the groin; in consequence of which, having at the time an inguinal rupture, mortification came on, and he died. Verdict, *Manslaughter.* The circumstances attending the case of *Bartholomew Quain* were, in some respects, different; he was tried and convicted for the murder of his wife, at the Assizes for the Isle of Ely, in 1790. It appeared in evidence, that a rupture of the spleen was produced by the violent kicks, of which the indictment stated that she had died. The jury, under the direction of the Chief Judge of Ely, found a special verdict, in order to take the opinion of the Court of King's Bench upon the following question, whether the facts found by the jury amounted to murder, or only to manslaughter, when the Court was clearly of opinion that it was murder, because there did not appear to have been any provocation on the part of the deceased; and no man had a right, even to inflict chastisement, without a just provocation.

Lacerations, where the integuments are torn.—These differ from incised wounds not only in the circumstance of their being less disposed to heal by the first intention, but in the singular fact of their not bleeding to any extent; there are perhaps no facts, in the history of surgery, more extraordinary than those which have been recorded on the subject of whole limbs being torn away, without hemorrhage. The most remarkable of these is related by *Cheselden*, in his work on Anatomy, being the case of a miller, "whose arm, with the scapula, was torn off from his body, by a rope winding round it, the other end being fastened to the coggs of a mill; there was no hemorrhage, nor did any severe symptoms supervene, so that the wound was cured by superficial dressings only, the natural skin being left almost sufficient to cover

it." Analogous cases are recorded by *La Motte*, in his *Traité des Accouchemens*; by Mr. *Carmichael*, in the fifth volume of the *Edinburgh Medical Commentaries*; and by others, in the second volume of the *Mem. de l'Acad. de Chirurgie.* In appréciating the degree of danger attendant upon wounds of this description, the practitioner must not overlook the possible occurence of Tetanus.

Gun-shot wounds. Long after the invention of gunpowder, Surgeons continued to entertain very vague opinions respecting the nature of wounds produced by it; some considered that the injured parts were either dreadfully burnt by the heat of the projected body, or were irritated by the presence of poison, communicated to them by the powder. *Thomas Gale*, who served as a Surgeon in the army of *Henry* 8th, at Montreuil in 1554, was the first to refute the absurd opinions of "the poisoning, burning, and conquassation of gun-shot wounds." A gun-shot wound is now defined "a violent contusion, with, or without a solution of continuity, suddenly and rapidly effected by a solid body projected from fire-arms." If a musket or pistol ball has struck a fleshy part, without injuring any material blood-vessel, we see a hole about the size of, or smaller than the bullet itself, with a more or less discoloured lip forced inwards, and if it has passed through the parts, we find an everted edge, and a more ragged, and larger orifice at the point of its exit; the pain in this case is so inconsiderable that the wounded person is frequently not aware of his having received any injury. The course of balls is frequently most extraordinary, and it behoves the judicial surgeon to keep in mind a fact which may often throw considerable light upon the subject of his investigation. A ball will often strike the thorax or

abdomen, and, to an inexperienced eye, appear to have passed directly across, or to be lodged in one of the cavities. If great difficulty of breathing or hemorrhage from the mouth, with sudden paleness and laborious pulse, in the one case, or deadly faintness, coldness of the extremities, and the discharge of stercoraceous matter from the wound, in the second, are not present, we shall perhaps find that the ball has coursed along under the integuments, and is marked in its progress either by a redness, which Mr. *Hunter* compared to a blush, or by a wheal, or dusky line, terminated by a tumour, on the opening which it will be easily extracted. In some of these long and circuitous routes of balls, where we have not this mark, a certain emphysematous crackling discovers their course, and leads to their detection. The ball is in many instances found very close to its point of entrance, having nearly completed the circuit of the body. In a case related by Dr. *Hennen*, as one that occurred to a friend of his in the Mediterranean, the ball, which struck about the *Pomum Adami*, was found lying in the very orifice at which it had entered, having gone completely round the neck, and being prevented from passing out by the elasticity and toughness of the skin which had confined it to this circular course. This circuitous route is a very frequent occurrence, particularly when balls strike the ribs, or abdominal muscles, for they are turned from the direct line by a very slight resistance indeed, although they will at times run along a continued surface, as the length of a bone, along a muscle, or a fascia, to a very extraordinary distance. If there is nothing to check its course, and if its momentum be very great, it is surprising what a variety of parts may be injured by a musket ball. Dr. *Hennen* states

that in one instance, which occurred in a soldier, who having his arm extended in the act of endeavouring to climb up a scaling ladder, had the centre of his humerus pierced by a ball, which immediately passed along the limb, and over the posterior part of the thorax, coursed among the abdominal muscles, dipped deep through the glutæi, and presented on the fore part of the opposite thigh, about midway down. In another case, a ball which struck the breast of a man standing erect in the ranks lodged in the scrotum. The propensity of balls to take a curved direction is often seen in their course on a concave surface; in short, they take very unusual and deep-seated routes, not at all to be accounted for by any preconceived theories drawn from the doctrine of projectiles, nor to be explained by diagrams founded upon mathematical rules. These considerations ought to render the Surgeon very cautious how he delivers his opinion, as to the direction in which the shot was fired, and yet instances frequently occur where no difficulty can arise upon this point, such was the case of *Richard Annesley*, tried for the murder of *Thomas Eglestone* (9 *Harg. Sta. Tri.* 327). The deceased was a poacher. *Annesley* who was in company with the game-keeper, stated in his defence, that his gun had accidentally gone off in his attempt to secure the deceased. The instructions given by the Court on this occasion was that if the jury were of opinion that the gun had so gone off accidentally, they should bring in a verdict of *Chance-medley*, which was returned accordingly, in consequence of the evidence of the Surgeon who had examined the wound, and stated that its direction being upwards, very satisfactorily proved that the fowling-piece had not been levelled from the shoulder, which would have implied design; but must have

been discharged at the trail, which must have been accidental. (*a*) An idea long existed that a ball might produce injury without striking any part of the body; this was supposed by some to arise from the violent commotion produced in the air by the rapid motion of the ball; and by others, to depend upon an electrical shock on the parts, in consequence of the ball being rendered electrical by friction in the calibre of the gun, and giving off the electrical matter as it passes by. This, however, is contrary to all our received notions respecting electricity; metals can never acquire such a property by friction.

In avowing our total disbelief in the existence of such *wind-contusions*, as they have been called, we are well aware that we shall oppose many very respectable authorities. "*Amicus Plato, sed magis amica Veritas.*"

An important question, connected with the present subject, still remains for elucidation; where a body has been found dead with wounds and contusions, by what signs we are to determine whether they were inflicted during life, or after death. As the solution of this interesting problem requires various data, its consideration will be reserved for that part of our work, where all the Objects of Inquiry, in cases of sudden and mysterious death, are considered in their various relations to each other, with a view to appreciate their individual and joint importance.

(*a*) This trial is the more remarkable as forming one of the numerous persecutions to which the prisoner claimant of the Annesley Peerage was subjected by the rancour of his opponent; for the other proceedings *see State Trials.*

BY POISONING.

No species of murder is so base and cowardly, or so cool and deliberate in its perpetration as murder by poison, which because of its secresy prevents all precaution, whereas most open murder gives the party killed some opportunity of defence; (*a*) it is generally committed in violation of domestic duty and confidence, and too frequently evinces that unrelenting and barbarous depravity, which can witness the sufferings of its victim for days nay months unmoved; therefore our ancient laws adjudged those convicted of poisoning to a severer punishment than other offenders. 3 *Nels. Abr.* 363. *Jac. Law Dict. tit. Poison.* By the 22 *Hen.* 8. it was *ex post facto* enacted that *Richard Roose*, (or *Cooke*), for putting poison into a pot of pottage in the Bishop of Rochester's kitchen, by which two persons were killed, should be boiled to death; and that the offence in future should be adjudged High Treason; but this among other new treasons (with which the reign of *Henry* the 8th had abounded) was abolished by the statute of *Edward* 6, and now to poison any one wilfully is murder if the party die in a year. 1 *Edw.* 6. *c.* 12.

By the 43 *Geo.* 3. *c.* 58. (commonly called Lord *Ellenborough's* Act) any person administering poison

(*a*) Poisoning, in war, is even considered by the law of nations as more odious than assassination, of this *Grotius* (lib. iii. c. 4) has enlarged. It was a maxim of the Roman senate, that war was to be carried on by arms, and not by poison (*Aul. Gell. Nat. Attico.* lib. iii. c. 8.). Even *Tiberius* rejected the proposal made by the Prince of the Catti, that if poison was sent to him, he would destroy *Arminius*; he received for answer, that the Roman people chastised their enemies by open force, without having recourse to wicked practices and secret machinations (*Val. Max.* l. iv. c. 5.)

with *intent* to murder another, (though no death ensue) or to procure the miscarriage of a woman quick with child, is declared guilty of felony without benefit of clergy: and persons administering medicines to procure miscarriage, though the woman is not quick with child, are declared guilty of felony, punishable by imprisonment or transportation (*vide post*). If a man persuade another to drink a poisonous liquor, under the notion of a medicine, who afterwards drinks it in his absence, or if *A*, intending to poison *B*, put poison into a thing, and deliver it to *D* who knows nothing of the matter, to be by him delivered to *B*, and *D* innocently delivers it accordingly in the absence of *A*; (*a*) in this case the procurer of the felony is as much a principal as if he had been present when it was done (2 *Hawk. P. C.* 443: *Vin. Ab. tit. Accessory*) or if one mix poison with any eatable with intent to kill another, and a stranger casually eat it and die, (*b*) it is murder; *Dalton*, 93. *Agnes Gore's* case for poi-

(*a*) See also 4 *Co. R.* case of *Vaux*, who was executed for poisoning with Cantharides. "Persuadebat eundem Nichol' recipere et bibere "quemdam potum mixtum cum quodam veneno vocat cantharides, af- "firmans et verificans eidem Nichol' quod præd' potus sic mixtus cum "præd' veneno vocat' canth' non fuit intoxicatus (Anglice poisoned) "sed quod per reception' inde præd' Nich' exit' de corpore dictæ Mar- "garetæ tunc uxoris suæ procuraret et haberet." It is to be hoped that the age of Philtres and love powders is passed.

(*b*) At Warwick Assizes, 18 *Eliz. John Saunders* and *Alexander Archer* were indicted for the wilful murder of *Eleanor Saunders*, an infant of 3 years of age, daughter of the first prisoner. *Saunders* wishing to get rid of his wife consulted *Archer*, by whose advice he gave her (being ill) a roasted apple, with which he had mixed *arsenic* and *roseacre*. She ate a small part of it, and in his presence gave the remainder to the infant, for which *Saunders* reprehended her, saying apples were not good for such children, but he permitted the child to swallow the poison, lest he should be suspected. He was condemned and executed, but a point was reserved as to the guilt of his accomplice *Archer*, for which, see *Plowden's Rep.* 474.

soning by ratsbane (9 *Co. Rep.* 81: *Palm. R.* 547.), not so if it be to kill vermin; but query if it be manslaughter where there is not proper precaution, as where the poison is laid in ordinary places for keeping meat, and mixed with ordinary food, so that a child may take it. 1 *East. P. C.* He that counsels another to give poison, if that other doth it, the counsellor, if absent, is accessory *before*. *Coke, P. C.* 49. Case of the murder of Sir *Thomas Overbury*, *Harg. St. Trials*. But he that absolutely gives or lays the poison, to the intent to poison, though he be absent when it is taken by the party, yet he is principal, and this was *Weston's* case. *Harg. St. Trials*: *Co. P. C. p.* 49. *Vaux's* case, *ubi supra*. and *Donellan's* case for the murder of Sir *Theodosius Boughton*, *Warwick Assizes*, 1784. See *Appendix*, 243.

It is not our intention to detail every mode by which murder by poison may be committed; too many are already known to the world in general; on those which are known, we may safely comment; nor would there be as much mischief as is commonly supposed in hinting at some others; for if any should study this subject with evil intention, he may be assured that the progress of modern science, though it may have discovered some new modes of destruction, has been yet more fertile in antidotes for the injured, and in means of detecting the guilty.

OF POISONS,

CHEMICALLY, PHYSIOLOGICALLY, AND PATHOLOGICALLY CONSIDERED.

Toxicology, or the history of Poisons, forms one of the most important and elaborate branches of Forensic Medicine, and in tracing the subject through all its numerous and interesting relations to Jurisprudence, we shall experience no small degree of gratification by observing, how greatly and progressively this obscure department of science has, within the last few years, been enlightened by the discoveries of Chemistry and Physiology.

The labours of the modern Chemist, indeed, have enabled us to recognise and identify each particular substance by its properties and habitudes, with an infallible delicacy, which the Physicians of a former age could scarcely have anticipated, and much less practised.

The Physiologist, by an invaluable series of observations and experiments, has demonstrated the particular organ, or texture, upon which each individual poison exerts its energies; and the Pathologist has been thus enabled to establish the mode in which it depraves the health, or extinguishes the life of an animal. Nor has the Anatomist withheld his contributions upon this interesting occasion, for he has demonstrated the situation, extent, and intensity of the organic lesions which result from the operation of these terrible agents upon the living body; and has pointed out several appearances which occur from natural causes, but which might be mistaken by the

unskilful or superficial observer, for the ravages of poison. It remains for the Forensic Physician to converge into one focus the scattered rays which have thus emanated from so many points, and thereby to elucidate and determine the line of conduct which the medical attendant is called upon to pursue, for the relief of the patient suffering under the torments of poison, and for the establishment of the guilt or innocence of the party charged with the perpetration of a crime, which may be said to rob courage of its just security, while it transfers to cowardice the triumphs of valour. That engines so powerful and secret in their work of destruction, should have universally excited the terror of mankind is a fact which cannot surprise us, and, when we consider how intimate are the relations between fear and credulity, we need not seek farther for the solution of the many problems to which the exaggerated statements of ancient Toxicologists (*a*) have given origin; the most extraordinary of those relate to the alleged subtlety of certain poisons, which was believed to be so extreme as to defeat the most skilful caution, and at the same time so manageable, as to be capable of the most accurate graduation; so that, in short, the accomplished assassin was not only thus enabled to ensure the death of his victim through the most secret, and least suspicious agents, but to measure his allotted moments with the nicest precision, and to occasion his death at any period that might best answer the objects of the assassination. The writings of *Plutarch*, *Tacitus*, *Theophrastus*, *Quintillian*, and

(*a*) The study of poisoning appears to have been of considerable antiquity. *Ulysses* sought poison for his weapons from *Ilus*, "φαρμακον ανδροφονον" Od. l. 1. v. 261; but the conscientious pharmacopolist refused to furnish his dangerous preparations to the wily chief.

Livy, abound with such instances of *occult* and *slow* poisoning; most of which, however, notwithstanding the weight they may acquire from their testimony, bear internal evidence of their fallacious character. *Plutarch* informs us that a slow poison which occasioned heat, cough, spitting of blood, a lingering consumption of the body, and a weakness of intellect, was administered to *Aratus* of Sicyon. This same poison is also alluded to by *Quintillian* in his declamations. *Tacitus* (*a*) informs us that *Sejanus* caused a *secret* poison to be administered by an eunuch to *Drusus*, who in consequence gradually declined, as if by a consumptive disorder, and at length died. *Theophrastus* (*b*) speaks of a poison, prepared from Aconite, that could be so modified as to occasion death within a certain period, such as two, three, or six months, a year, and even sometimes two years.

To such an extent does the crime of poisoning appear to have been carried, about two hundred years before the Christian æra, that according to *Livy*, (*c*) above one hundred and fifty ladies, of the first families in Rome, were convicted and punished for preparing and distributing poison. The most notorious and expert character of this kind is handed down to us by the historians and poets under the name of *Locusta*, who was condemned to die on account of her infamous actions, but was saved in order that she might become a state engine, and be numbered, as *Tacitus* expresses it, "*Inter instrumenta regni.*" She was accordingly employed to poison *Claudius* by *Agrippina*, who was desirous of destroying the Emperor, and yet feared to despatch him suddenly, whence a slow poi-

(*a*) Taciti Annal: Lib: iv. c. 8.
(*b*) Hist: Plant. Lib: ix. c. 16, p. 189.
(*c*) Lib: viii. c. 18.

son was prepared by *Locusta*, and served to him in a dish of mushrooms, of which he was particularly fond, "*Boletorum appetentissimus*;" but it failed in its effects, as we learn from *Tacitus*, until it was assisted by one of a more powerful nature. "*Post quem nihil amplius edit.*" This same *Locusta* prepared also the poison with which *Nero* despatched *Britannicus*, the son of *Agrippina*, whom his father *Claudius* wished to succeed him on the throne. This poison appears to have proved too slow in its operation, and to have occasioned only a dysentery. The Emperor accordingly compelled her by blows and threats, to prepare in his presence one of a more powerful nature, and as the tale is related by *Suetonius*, it appears that it was then tried on a kid, but as the animal did not die until the lapse of five hours, she boiled it for a longer period, when it became so strong as instantaneously to kill a pig to which it was given. In this state of concentration it is said to have despatched *Britannicus* as soon as he tasted it. (*a*) Vide *Tac: An.* 13. *s.* 15. 16. Now it would clearly appear from these statements that *Locusta*, avowedly the most accomplished poisoner of ancient Rome, was wholly incapable of graduating the strength of her poisons to the different purposes for which they were applied.

The records of modern times will furnish examples no less atrocious than those we have just related. *Tophana*, a woman who resided first at Palermo, and

(*a*) For the ingenious mode in which this poison was administered, see *Tacitus*. The prince having called for a cup of wine, it was purposely presented too hot; he desired cold water to be added to it, and the opportunity was then taken to infuse the poison. By this stratagem the taster ("calida gelidæque minister." *Juv. Sat.* v. *v.* 63.) escaped its effects, in which he must otherwise have participated with *Britannicus*.

afterwards at Naples, may be considered as the *Locusta* of modern history; she invented and sold those drops so well known by the names of *Aqua Toffania*; *Aqua della Toffana*; *Acquetta di Napoli*, or simply *Acquetta*. This stygian liquor she distributed by way of charity to such wives as wished for other husbands; from four to six drops were sufficient to destroy a man, and it was asserted that the dose could be so proportioned as to operate within any given period. (*a*) It appears that in order to secure her poison from examination, she vended it in small glass phials, inscribed, "*Manna of Saint Nicolas Bari*," and ornamented the vessel with the image of the Saint. Having been put to the rack she confessed that she had destroyed upwards of six hundred persons, for which she suffered death by strangulation in the year 1709 (*b*). In 1670 the art of secret poisoning excited very considerable alarm in France; the *Marchioness de Brinvillier*, a young woman of rank and great personal beauty, having intrigued with, and subsequently married an adventurer named *Saint Croix*, acquired from him the secret of this diabolical act, and practised it to an extent that had never before been equalled. She poisoned her two brothers through the medium of a dish at table. She also prepared poisoned biscuits, and to try their strength she distributed them herself to the poor at the Hotel Dieu. Her own maid was likewise the subject of her experiments. To her father she gave poisoned broth, which brought on symptoms characteristic of those induced by corrosive sublimate. Her brothers lingered during seve-

(*a*) The reader will find a very interesting account of this diabolical woman in *Labat's Travels through Italy*, and also in *Beckman's History of Inventions*.

(*b*) *Haffman* Medicin. Rational.

ral months under much suffering. The detection of this wretch is said to have been brought about in the following manner. *Saint Croix*, whenever engaged in the preparation of his poisons, was accustomed to protect himself from their dangerous fumes by wearing a glass mask, which happening to fall off by accident, he was found dead in his laboratory. (*a*) A casket directed to the Marchioness, with a desire that in case of her death it might be destroyed unopened, was found in his chamber, a circumstance which in itself was sufficient to excite the curiosity and suspicion of those into whose hands it fell. The casket was accordingly examined, and the disclosure of its contents at once developed the whole plot, and finally led to the conviction of this French Medea, who after a number of adventures and escapes, was at length arrested and sent to Paris, where she was beheaded, and then burnt, on the 11th of July, 1676. The practice of poisoning, however, did not cease with her execution, and it became necessary in 1679 to establish a particular Court, for the detection and trial of such offenders; which continued for some time to exert its jurisdiction under the title of CHAMBRE DE POISON, or CHAMBRE ARDENTE.

With respect to the secret modes in which poisons have been supposed capable of acting, mankind have ever betrayed the most extravagant credulity, of which the numerous tales upon record afford ample proof; such as that reported of *Parasapis* by *Plutarch*, from *Ctesias*, in his life of *Artaxerxes*, who, it is said, by anointing a knife on one side by poison, and therewith dividing a bird, poisoned *Statira* with one half, and with the other regaled herself in perfect security.

(*a*) This story, if we mistake not, suggested to the successful author of Kenilworth, the tragic death of his Alchymist.

We are also told of *Livia* who poisoned the figs on a tree which her husband was in the habit of gathering with his own hands. *Tissot* informs us that *John*, king of Castille, was poisoned by a pair of boots prepared by a Turk; *Henry* VI, by gloves (*a*); Pope *Clement* VII, by the fumes of a taper (*b*); and our king *John*, in a wassail bowl, contaminated by matter extracted from a living toad. To these few instances of credulity may be added the offer of the priest to destroy queen *Elizabeth* by poisoning her saddle (*c*), and the *Earl of Essex*, by anointing his chair.

Incredible and absurd as these opinions now appear, they continued until a late period to alarm mankind, and to perplex and baffle judicial investigations; even *Lord Bacon* in his charge against the *Earl of Somerset* for the murder of *Sir Thomas Overbury*, in the Tower, seemed to give credit to the story of *Livia*, and he seriously stated, that "*Weston* chased the poor prisoner with poison after poison; poisoning salts, poisoning meats, poisoning sweetmeats, poisoning medicines and vomits, until at last his body was almost come, by the use of poisons, to the state that *Mithridates's* body was by the use of treacle and preservatives, that the force of poisons was blunted upon him;" *Weston* confessing, when he was reproached for not despatching him, that he had

(*a*) The belief in the possibility of poisoning by the vestments is very ancient, as is shewn by the fabled death of Hercules.

———— "Capit inscius heros:
Induiturque humeris Lernææ virus Echidnæ.
———————————————
———————————————
Incaluit vis illa mali; resolutaque flammis;
Herculeos abiit late diffusa per artus."

Ovid. Metam. Lib. ix. *v.* 157.

(*b*) Quæst. Med. Leg.

(*c*) *Sir Edward Coke in the trial of Sir John Hollis.*

given enough to poison twenty men. (*a*) The power of so graduating the force of a poison as to enable it to operate at any given period seems to have been considered possible by the earlier members of the Royal Society, for we learn from *Spratt's* history of that learned body, that very shortly after its institution, a series of questions were drawn up by the direction of the Fellows, for the purpose of being submitted to the Chinese and Indians, viz. "*Whether the Indians can so prepare that stupifying herb, Datura, that they make it lie several days, months, years, according as they will have it, in a man's body, without doing him any hurt, and at the end kill him without missing half an hour's time?*"

That mankind were, in a very early stage of their existence, not only acquainted with the deadly effects of certain natural substances when applied in minute quantities, but that they availed themselves of such knowledge for the accomplishment of the worst purposes, is very satisfactorily shewn by the records of sacred as well as profane authors. But such is the ambiguity of ancient writers upon this subject, and so intimately blended are all their receipts with the practices of superstition, that every research, however learned, into the exact nature of the poisons which they employed, is necessarily vague and unsatisfactory. Of this one fact, however, we may be perfectly satisfied, that they were solely derived from the animal and vegetable kingdoms, for the discovery of mineral poisons was an event of later date; owing however to the defect of botanical nomenclature, it is even doubtful whether the plants which are designated by the terms *Cicuta*, *Aconitum*, &c. in ancient authors, were identical with those we designate by

(*a*) *Bacon's* works. vol. ii. p. 614.

the same names. (See *Pharmacologia*, edit. v. vol. 1, p. 66.) With respect to the poisons of *Locusta*, all cotemporary writers speak of the venom of the toad as the fatal ingredient of her potions, and in the Alexipharmaca of *Dioscorides* we find the symptoms described, which are said to be produced by it; (*a*) but what is very extraordinary, the belief of the ancients on this matter was all but universal. *Pliny* is express on the subject; *Ætius* describes two kinds of this reptile, (*b*) the latter of which, as Dr. *Badham* has suggested, was probably the frog, as well from the epithet, as that he ascribes deleterious powers only to the former. It is scarcely necessary to observe that this ancient belief has descended into later times; we find Sir *Thomas Browne* treating such an opinion as one of the vulgar errors; and we have before alluded to the legend of king *John* having been poisoned by a wassail bowl in which matter extracted from a living toad was said to have been infused. In still later times, we have heard of a barrel of beer poisoned by the same reptile having found its way into it. *Borelli* and *Valisnieri* maintain that it is perfectly harmless, and state that they had seen it eaten with impunity. *Spielman* (*c*) expresses the same opinion, "*Minus recte itaque effectus venenati a bufonibus metuuntur.*" *Franck*, (*d*) on the contrary, accuses *Gmelin* of too much precipitancy in rejecting the belief respecting toad-poison. (*e*) Modern natu-

(*a*) "επίφερεν οιδημαλα σωμαλος, μελα ωχροϊηλος επιλελαμενης. δυσπνοειν και δυσωδια οδωδεναι το ϛομα, και λυγμος αυλοις ἐπεϊαι, ενιοϊε δε και σπερμαλος απροαιρελος εκκρισις."

(*b*) 1. κωφος η αφθογγος; 2. φωνηλικος.

(*c*) Instit. Mater. Medic. p. 176.

(*d*) *Manuale di Tossicologia*, p. 79. 245.

(*e*) See also *Istituzioni di Med. For. di G. Tortosa*, vol. 2. p. 67, and authorities there cited.

ralists recognise no poisonous species of toad; even the most formidable of the species, to appearance, that of Surinam, is said to be perfectly harmless.

If we may venture to offer a conjecture upon this subject, we are inclined to consider the origin of this opinion to have been derived from the frequency with which the toad entered into the composition of spells or charms, into philtres or love potions, and which, like the bat and the owl, most probably derived its magical character from the gloom and solitude of its habitation. *Shakspeare* has accordingly introduced this reptile into the witches' enchanted cauldron, in *Macbeth.*

> "Round about the cauldron go;
> In the poison'd entrails throw.
> Toad that under coldest stone
> Days and nights hast thirty-one
> Swelter'd venom sleeping got,
> Boil thou first i' the charmed pot!"

This opinion receives further strength when it is considered how frequently poisons were administered under the insidious form of charms or incantations. (*a*)

It has, however, been shewn by late experiments that the toad has, under particular circumstances, the power of ejecting from the surface of the body an acrid secretion which excoriates the hands of those that come in contact with it; and this fact may perhaps have assisted in supporting the general belief respecting the poisonous nature of this reptile. *Pelletier* has ascertained, that this corrosive matter, contained in the vesicles which cover the skin of the common toad, (*Rana Bufo*) has a yellow colour, and

(*a*) This fact may be illustrated by ancient as well as modern records; from the poisoned tunic of the Centaur Nessus, to the treacherous powders of the diabolical *Mary Bateman.*

an oily consistence, and to consist of,—1st, an acid partly united to a base, and constituting $\frac{1}{20}$th part of the whole. 2d, very bitter fatty matter. 3d, an animal matter bearing some analogy to gelatine.

It would also appear from the writings of *Dioscorides*, *Galen*, *Nicander*, *Ætius*, *Ælian*, and *Pliny*, that the ancients derived a very energetic poison from the Sea Hare, *Lepus Marinus*,—the *Aplysia Depilans* of *Linnæus*; and, if we may credit *Philostratus*, it was with such a poison that *Titus* was killed by *Domitian*.

There is, however, ample ground for supposing that the poisons of the ancients were, for the most part, obtained from the vegetable kingdom, and from the class of Narcotic plants; (*a*) that they were compounded of a great variety of such ingredients, together with others that were quite inert and useless, and which merely served to disguise their composition.

Ancient writers also allude to the blood of the bullock as a poison; *Themistocles* is said by *Plutarch* to have destroyed himself by this fluid; and *Strabo* states that *Midas* died of drinking the hot blood of this animal, which he did, as *Plutarch* mentions, to free himself from the numerous ill dreams which continually tormented him. Some historians assign the death of *Hannibal* to the same draught.

With respect to the poisons employed by *Tophana*, the Locusta of modern days, and her infamous successors, there is less doubt; *Arsenic*, *Corrosive Sublimate*, *Sugar of Lead*, and *Antimony*, (*b*) were amongst the

(*a*) Theophrast. *Hist. Plant.* lx. c. 16. Strabo mentions the action of the *Lauro-cerasus*, as a poison, and observes that it occasions a death like that of Epilepsy.

(*b*) All these substances were found in the casket of *Saint Croix*.

most powerful of their instruments of torture and death. According to the declaration of the Emperor *Charles* VII to his physician *Garelli*, the *Aqua Toffania* was a solution of arsenic in *Aqua Cymbalariæ*. (*a*) Dr. *Hahneman* considered its basis to have been an arsenical salt. Others have, with little probability, regarded Opium and Cantharides as the active ingredients. *Franck*, (*b*) speaking of the *Aqua Toffania*, agrees with *Gmelin*, (*c*) that it is no other than a solution of arsenic. The *Pulvis Successionis*, another instrument of death, whose title announces the diabolical intention with which it was administered, has been supposed to have been a preparation of lead; while others have considered it to have consisted of diamond dust, and to have acted mechanically.

Having thus noticed a few of the more remarkable and interesting features in the literary history of Toxicology, we shall proceed to consider the subject of Poisons, in relation to their operation.

A Poison, (*Toxicum*, *Venenum*, *Virus*), has been very correctly defined by *Gmelin* to be a substance which when administered internally, or applied externally, in a small dose, impairs the health, or destroys life. This definition is adopted by *Mead*,

(*a*) *Gerarde*, in his Herbal, considers the *Cymbalaria* to be the Pennywort of which he describes two varieties, viz. the Wall-pennywort, and the Water-pennywort; and he blames the "ignorant apothecaries," for using the latter instead of the former, as extremely dangerous and destructive to life. Modern botanists consider it as an *Antirrhinum*,—A. Cymbalaria. Lin. i. e. Ivy-leaved Toad-flax. We are not aware of any part of this genus being poisonous. The *A. Linaria*, common Toad-flax, appears to be the only one to which any medicinal virtues have been ascribed. *Linnæus*, however, says (Flor. Suec.) that this plant is used as a poison to flies.

(*b*) Man. de Toxicol.

(*c*) Hist. General de Venen. mineral.

Sproegel, *Plenck*, and *Tortosa*, and is to be preferred to every other, (*a*) not only for its simplicity, but for its independence of any theory relative to the *modus operandi* of such agents. But it will be seen that, by accepting this definition, we are necessarily led to admit the fact, that poisoning may be acute, or chronic, that is to say, that it may at once destroy life, or produce a disease which can be protracted to any indefinite period. After the erroneous and vague notions which have been entertained upon the subject of "*Slow poisons*," it is highly essential that the latitude of our belief should be accurately ascertained, and the precise meaning of our terms defined.

OF SLOW, CONSECUTIVE,* AND ACCUMULATIVE POISONING.

1. *Slow Poisons.* According to the popular acceptation of the term, they may be defined, *Substances which can be administered imperceptibly; and a single dose of which will operate so gradually, as to shorten life like a lingering disease; their force, at the same time, admitting of so nice an adjustment as to enable the*

(*a*) BOERHAAVE gives us the following definition. "*Venenum dico omne illud quod ingestum vel applicatum corpori, talem in corpore humano mutationem excitat, quæ per ipsam eam mutationem non superatur. Medicamentum præterea in eo differt, quod ipsa, quam facit mutatio, in sanitatem tendat, venenum vero corpus mutat, ut ex sano ægrum fiat, aut cadaver.*" (Prælect. Acad. T. vi, p. 283.) HOFFMANN has furnished us with a definition less exceptionable than the foregoing, but still inferior to that of *Gmelin*. "*Alit natura res, quæ exigua mole et summa partium tenuitate, brevi tempore, concentum atque ordinem motuum vitalium pervertunt, vel plane destruunt; et hæ vocari solent Venena.*" (M. R. S. T. II. p. 88.)

* We have adopted this term, as one that has been in previous use, although we are by no means satisfied that a more expressive word might not be found.

artist to occasion death at any required period. We have now to inquire how far such alleged powers are consistent with the known laws of physiology. It cannot be denied that certain substances have been introduced into the alimentary canal, where they have remained for an indefinite period, without occasioning the slightest inconvenience, and at length excited a disease that has terminated fatally; in the *London Medical and Physical Journal* for February 1816, a case is related in which death was occasioned by a chocolate-nut having lodged in the entrance of the *Appendix Vermiformis*; and in the *Edinburgh Medical and Surgical Journal* for July 1816, we have an analogous case, communicated by Dr. *Briggs* of Liverpool, where the *Appendix cœci* sphacelated, owing to the irritation of a human tooth which was found sticking in its cavity. Mr. *Children* has lately communicated to the Royal Society a case where a concretion in the colon produced death; upon examination it was found to contain a plum-stone, as a nucleus, and to consist of a fine fibrous vegetable substance, from the inner coat enveloping the farina of the oat, and which was derived from the oatmeal upon which the deceased had fed. (*Phil. Trans.* 1822.) However disposed we may feel, by a forced construction of the term, to consider such agents as *slow* poisons, it is very evident that they can rarely have been made subservient to the purposes of secret poisoning; although a case occurred in the practice of the author, (*a*) in which a girl swallowed six copper pence for the avowed purpose of destroying herself; the coin produced a disease which remained chronic for a very considerable period, when, after a lapse of five years,

(*a*) This case is detailed in his 'Pharmacologia,' under the article *Cupri Sulphas.*

they were voided, and the young woman recovered. A similar attempt was also made by *Theodore Gardelle*, after his conviction for the murder of Mrs. *King* (*vide ante*), he swallowed a number of halfpence, for the purpose of destroying himself, but without any ill effect. Dr. *Baillie*, in his '*Morbid Anatomy*,' relates an instance where five halfpence had been lodged in a pouch in the stomach for a considerable time, without occasioning any irritation; and Mr. *A. Thomson* has also furnished us with two analogous cases in children, in one of which the copper coin remained six months in the intestines, and in the other, two months. These facts furnish sufficient data to enable the practitioner to appreciate the degree of danger attendant upon such agents, and to determine how far they can ever become successful instruments in the hands of the assassin. (*a*)

But it has been supposed that certain bodies, as glass, enamel, diamonds, (*b*) agates, smalt, &c. when administered in the form of powder, so lacerate the membranes of the stomach, by the sharpness of their particles, as slowly to destroy life; and upon the same principle, it has been asserted, that human hair, chopped fine, (*c*) constitutes the active ingredient of a slow poison frequently employed in Turkey, and that

(*a*) See an interesting paper by Dr. *Marcet*, in the 12th volume of the Medico-Chirurgical Transactions, entitled, "*Account of a man who lived ten years after having swallowed a number of clasp knives.*"

(*b*) In the reign of Louis XIV, *Henrietta*, Duchess of Orleans, is said to have been poisoned by diamond-dust mixed with powdered sugar. The same substance is enumerated among other extraordinary poisons, as having been administered in the case of *Sir Thomas Overbury*.

(*c*) Old women in the country recommend the same remedy for the destruction of worms; probably the medicine and the poison may be equally effective.

it induces, by irritation, a chronic disease resembling cancer. With respect to the danger arising from the ingestion of diamond dust, enamel powder, powdered glass, and the like, there still may be said to exist some difference of opinion. *Caldani*, *Mandruzzato*, (*d*) and M. *Le Sauvage*, have reported experiments made upon men and inferior animals, in which no bad consequences followed the administration of such bodies; whereas *Schurigius* (*a*) and *Cardanus* (*b*) cite instances where persons have died of ulcerations of the stomach from such causes; and this opinion receives the support of *Plouquet*, (*c*) *Stoll*, (*d*) *Gmelin*, (*e*) *Foderé*, (*f*) *Mahon*, (*g*) *Franck*, (*h*) and many others. The modern pathologist will not find much difficulty in reconciling such conflicting testimony. The experimentalist may administer mechanical substances a thousand times without producing any ill effects, while, under certain circumstances, the most trivial body may lodge in the intestines and produce death; but surely the occasional occurrence of such accidents ought not to confer the general title of *poison* upon the substances which may happen to produce them.

Having thus disposed of a considerable number of bodies, which have been classed as *slow* poisons, we may proceed to observe that most of the other substances which have found a place in the same division, appear to us to deserve consideration under a very different head, and that we shall get rid of much obscurity by adopting the following arrangement.

(*d*) Saggi Scientif. e letter dell' Accademia di Padova. T. III. p. 11, p. 1.
(*a*) Chylologia. (*b*) De Venenis.
(*c*) Comment. super Homicid. p. 177.
(*d*) Ratio Medendi. Part VI, p. 60.
(*e*) Hist. General de Venenis Mineral.
(*f*) Med. Leg. Tom. II. p. 170.
(*g*) Tom. II. p. 346.
(*h*) Man. de Toxicol.

2. *Consecutive Poisoning.* Where the patient, having recovered from the acute effects occasioned by the ingestion of a *single* dose of poison, *subsequently suffers a series of symptoms from the injured structure to which it had given origin.* By referring to our definition of *slow* poisoning, we shall at once perceive the striking and important distinction between that and *Consecutive poisoning.* The following case, related by M. *Orfila,* may serve as an illustration. *Maria Ladan* drank by mistake a spoonful of *Aqua fortis,* the most violent symptoms supervened, but which by judicious treatment gradually subsided, when at length she passed by stool a long membranous substance, rolled up, and which represented the form of the æsophagus and stomach, and which, in fact, was found to be the interior membrane of these organs; from that moment the sensibility of the digestive organs became excessive, and two months after the accident she experienced a sudden shock and died. M. *Tartra,* in observing upon cases of this kind, asserts that the symptoms produced at first by the nitric acid decrease insensibly; and that at the end of a certain period, the internal membrane of the digestive canal is struck with death, and thrown off, and the person dies of a *Marasmus.* *Fordyce* (*a*) relates the case of a woman who was subject to cholics for the space of thirty years, in consequence of having *once* taken an infusion of the pulp of Colocynth prepared with beer. This was undoubtedly an extraordinary instance of idiosyncrasy, but it is probable that some organic lesion was occasioned by its operation, to which the subsequent suffering is to be referred. We have hitherto only considered the effects that may

(*a*) Fragmenta Chirurg. et Med. p. 66.

arise from the ingestion of a *single* dose of poison, but there are numerous and very interesting cases in which fatal results have been produced by the repetition of small doses at various intervals. We therefore propose a third, and new subdivision of our subject, viz.

3. *Accumulative Poisoning.*—By the repeated administration of a substance, in doses, of which no single one could occasion harm; but which, by gradually accumulating in the system, ultimately occasions disease, and death.

The familiar operation of mercury will at once suggest itself to the Physician, as a striking illustration of that species of poisoning which we have ventured to name *Accumulative*, and to the forensic student the effects of this metal, in reference to such a quality, will form a more than ordinary object of interest, as involving questions which have frequently embarrassed judicial inquiry; as, for instance, *Whether it can lie dormant any considerable time without betraying its effects upon the constitution*, and, having displayed its powers, and the symptoms having subsided, viz. salivation, &c. *Whether they can be renewed without a fresh application of the substance?* See Corrosive sublimate.

To how many substances this power of accumulation extends is at present not well understood. It may occur in those that act by absorption, and in those whose action is wholly local. Arsenic, digitalis, and several of the narcotic plants, as hemlock, may undoubtedly occasion serious mischief in this manner, as the author has more fully explained in another work, (*a*) and we have lately heard of

(*a*) Pharmacologia, Edit. v. vol. 1. p. 324.

several fatal cases arising from accumulated masses of magnesia in the *primæ viæ*, from the habitual use of small doses of that earth.

The history of many of the arts, especially those of metallurgy, would furnish also abundant examples of this kind of poisoning.

These few facts are we trust sufficient to authorise the foregoing arrangement, and we apprehend that the adoption of the distinctions, upon which it is founded, will be of great service in establishing fixed and definite notions with regard to the *chronic* operation of poisons. It may perhaps be useful to present the reader with a synoptical recapitulation of the subject.

A Slow Poison. A single dose is sufficient; which produces upon its administration no sensible effect, but gradually undermines the health.

A Consecutive Poison. A single dose is sufficient; producing the most violent symptoms, very shortly after its ingestion, but which gradually subside, and the patient is supposed cured; when, at some future period, death takes place from the organic lesions that had been occasioned.

An Accumulative Poison. Many doses are required; the effects being produced by the repetition of doses which would, *individually*, be harmless.

There still remains another point of view in which it is essential to regard the operation of a poison, in order to establish a distinction between those substances which, in a given dose, will destroy life under every circumstance of constitution, and those which

occasion death in consequence of some constitutional peculiarity in the individual to whom they may have been administered, and which are innocuous to the general mass of mankind; the gradations by which food, medicine, and poison, are thus enabled to branch into each other cannot be defined, because the circumstances with which they are related, defy generalization. The distinction, however, must be acknowledged and preserved, and we know no terms better adapted for expressing it than those of *Absolute* and *Relative* poisons; and our readers are accordingly requested to receive them in conformity with this explanation, whenever they occur in the following pages. Every work professing to treat the subject of Poisons, abounds with instances, in which articles that, by universal consent, are considered innocuous, have occasioned the most direful effects. *Morgagni* relates a case of a person who died from eating bread made with the farina of the chesnut. Dr. *Winterbottom* (*a*) says that he is subject to severe nettle-rash after eating sweet almonds. *Schenkius* relates a case in which the general law of astringents and cathartics was always reversed. *Donatus* tells us of a boy whose jaws swelled, whose face broke out in spots, and whose lips frothed, whenever he eat an egg: we might add many more examples, but it is needless to encumber a subject with illustrations which is already so obvious and indisputable. Nor do the anomalies of constitutional idiosyncrasies end here, for they not only convert food into poison, but they change poison into food, or at least, into a harmless repast. The most extraordinary exemplification

(*a*) See Medical Facts and Observations, Vol. v.

(*a*) See M. *Pouqueville's* "Voyage de Morée," also Mr. *Thornton's* Travels; and Notes to Lord *Byron's* Childe Harold's Pilgrimage.

of this on record is contained in the history of the old man at Constantinople, as related by M. *Pouqueville*, physician to the French army in Egypt, and who was a prisoner at Constantinople in the year 1798. "This man," says he, "was well known all over Constantinople, by the name of *Suleyman Yeyen*, or *Suleyman, the taker of corrosive sublimate.* At the epoch when I was there he was supposed to be nearly a hundred years old, having lived under the Sultans *Achmet* III, *Abdul Hamet*, and *Selim* III. He had in early life habituated himself to taking opium; but, notwithstanding that he constantly increased the dose, he ceased to feel from it the desired effect, and then tried sublimate, the effects of which he had heard highly spoken of; for thirty years this old man never ceased to take it daily, and the quantity he could now bear exceeded a drachm. It is said, at this epoch he came into the shop of a Jewish apothecary, and asked for a drachm of sublimate, which he swallowed immediately, having first mixed it in a glass of water. The apothecary, terrified, and fearing that he should be accused of poisoning a Turk, immediately shut up his shop, reproaching himself bitterly with what he had done; but his surprise was very great, when, the next day, the Turk came again, and asked for a like dose of sublimate."

Morbid states of the body may also exist which are capable of resisting, to a certain extent, or of modifying, the violent operation of particular poisons. In the history of the Royal Academy of Sciences for 1703, a case is related of a woman, who being tired out by a protracted dropsy, under which her husband had suffered, *charitably* administered to him fifteen or twenty grains of opium with the intention of despatching him; but the dose immediately produced such

copious evacuations by sweat and urine, that it restored him to health. This relation will immediately recal to the recollection of the classical reader the story, recorded by *Plutarch*, in his life of *Crassus*, of *Hyrodes* king of the Parthians, who having fallen into a dropsical complaint had poison (*Aconite*) administered to him by his second son, *Phraates*, but which, instead of destroying the king, as intended, cured his disease. The son, however, having thus failed in his attempt, shortly afterwards smothered his father with his pillow.

GENERAL REMARKS

ON THE MEDICAL EVIDENCE REQUIRED TO SUBSTANTIATE AN ACCUSATION OF POISONING.

Although the phenomena by which we are enabled to discover the administration of poison, will be fully enumerated, and carefully examined, under the history of each particular substance, and will necessarily vary according to the chemical properties, and physiological action of each individual poison; yet there are some general points of evidence, and several questions of importance, upon which it is very essential to arrive at some definite conclusion, some fixed understanding, before we proceed to the consideration of the particular details, and subordinate ramifications, of this complicated subject.

The great constituents which form the medical proof of poisoning, are derived from Chemical, Anatomical, and Pathological researches; viz—the existence of poison in the stomach or intestines; the morbid appearances, corresponding to such poison, upon dissection; and the characteristic symptoms which accompanied the action of it, previous to death. Where these circumstances occur in combination, the demonstration may be said to be complete, for we have arrived at absolute certainty.

But scientific evidence, short of such perfection, may be amply sufficient to lead to conviction. The fact of a poison having been found in the body may supersede the necessity of pathological testimony: thus *Hoffman*, (*a*) "*Si venenum adhuc intra ventricu-*

(*a*) M. R. S. T. iv. Part iii, p. 278.

lum reperitur, res est clarissima, ubi vero, illud haud deprehenditur, res adhuc dubii plena est." We shall hereafter find that the discovery of organic lesions, without the chemical proof ("*experimentum crucis* (*a*)") is often vague, and seldom satisfactory, and that even when sanctioned by the testimony of the pathologist, will frequently be deemed insufficient to sustain an indictment, unless indeed it be collaterally supported by a very strong chain of circumstantial evidence of a moral nature, especially such as relates to the character, conduct, and presumed object of the prisoner.

As the duty of the medical witness, upon such occasions, must always be anxious, and generally perplexing, it becomes our duty at least to clear away those adventitious difficulties with which ignorance on the one hand, and sophistry on the other, have obstructed a path of inquiry, which, from its very nature and direction, must necessarily be obscure and intricate.

We shall endeavour upon this, as we have upon similar occasions, to bring the more leading and popular points of controversy within the scope of a few prominent questions, assigning to each a share of attention, commensurate with our idea of it importance.

Q. 1. *Whether all, or most of the symptoms, characteristic of the action of corrosive and narcotic poisons, may not arise from morbid causes of spontaneous origin?*

(*a*) For the purpose of propitiating the favour of heaven, the alchymist stamped the figure of the cross upon the vessel, in which he expected to obtain the long sought prize that was to convert the baser metals into gold, whence the term *Crucible* derived its origin. And when the experiments of chemistry began to be considered as the true tests of philosophical truth, the expression of "*Experimentum crucis*" was adopted to signify the highest degree of proof of which a subject is susceptible.

Q. 2. *Whether organic lesions, similar to those produced by poisoning, may not occasionally result from natural causes?*

Q. 3. *Whether the rapid progress of putrefaction, in the body generally, or in any particular part, is to be considered as affording any presumptive evidence, in favour of a suspicion of poisoning?*

Q. 4. *How far the absence of poison, or the inability of the chemist to detect it, in the body, or in the fluids ejected from it, is to be considered as a negative to an accusation of poisoning?*

Q. 5. *What degree of information can be derived from administering the contents of the stomach of a person supposed to have been poisoned, to dogs, or other inferior animals?*

We shall now consider these questions in succession.

Q. 1. *Whether all, or most of the symptoms, characteristic of the action of corrosive and narcotic poisons, may not arise from morbid causes of spontaneous origin?*

It must be admitted that the symptoms produced by violent irritation in the primæ viæ, are not characterised by a diversity, corresponding with that of the causes which may excite it; thus it is, that we have a disease to which the term "*cholera*" has been assigned, and which is indicated by the following symptoms, "*Humoris biliosi vomitus, ejusdem simul dejectio frequens; anxietas; tormina; surarum spasmata,*" (Cullen Syn: LX. 1.) symptoms which supervene, and with nearly the same force, the spontaneous effusion of acrid bile into the intestines, and the in-

gestion of some acrid poison; and hence the nosologist has very properly divided *cholera* into two species, viz.

C. *Spontanea*, "Tempestate calida, sine causa manifesta oboriens."

C. *Accidentalis*, "A rebus acribus ingestis."

The problem therefore for solution, is the mode of distinguishing the two species from each other. Although the leading characters are, as we have said, the same in both, such as bilious vomiting, and purging, violent tormina of the bowels, cold sweats, cramps, faintings, and death, yet by a careful and circumstantial examination of the case, the intelligent practitioner will generally be enabled to arrive at a probable conjecture; the season of the year (*a*), the prevailing epidemics, the age (*b*) and constitutional predisposition of the patient, his habit with respect to diet, are circumstances which will greatly assist the diagnosis. The progress of cholera morbus is also rarely, or never, fatal in this climate, especially in so short a period as that in which death occurs from the operation of a violent, corrosive poison. (*c*)

(*a*) *Sydenham* considered the occurrence of cholera, as a disease in England, to be confined to the month of August, at which time, says he, it appears as certainly as swallows in the early spring, or cuckows at the approach of summer; but he himself observed it to appear sometimes towards the end of summer, when the season was unusually warm; and that the violence of the disease was in proportion to the degree of heat. *Note. Mrs. Downing* died in November, and *Miss Burns*, whose case is so frequently alluded to in this work, in March.

(*b*) Youths and adults are more generally affected than children and old persons.

(*c*) *Sydenham* describing the violent symptoms of cholera concludes by observing, "and such like symptoms as frighten the by-standers, and kill the patient in 24 hours." Syd. Sect. iv, c. 2. It must be remembered that *Sydenham* is here describing an extreme case. The unfortunate *Mrs. Downing* (see Appendix, p. 277.) died in fourteen hours!

There are besides in this latter case, very frequently other symptoms which do not attend *cholera spontanea*, (*a*) such as sanguineous vomiting, extreme burnings in the æsophagus and region of the stomach, swollen countenance, great dryness and tumefaction of the fauces, peculiar fætor of the breath, ischuria, with discharges of bloody urine, and ulcerations about the fundament (*b*); this latter symptom was particularly remarkable in the case of *Mr. Blandy*, whose history, as related by his physician, *Dr. Addington*, will be found in our *Appendix*, *p.* 236, and well deserves the attentive consideration of the medical jurist. The matter voided will also sometimes lead to a just diagnosis; in the true cholera *spontanea* there is a discharge of almost pure bile by vomiting and stool, simultaneously or alternately; now, although the same vomiting and purging may arise from the action of a poison, yet it does not follow that the matter discharged is bilious. The evidence delivered on the extraordinary trial of *Donnall*, for the wilful murder of his mother-in-law, *Mrs. Elizabeth Downing*, has been also printed in the *Appendix*, as well illustrating those doubts with which the present question is naturally encompassed. An opinion has existed that the appearance of jaundice during, or after the severe symptoms of *cholera*, offers a satisfactory proof of its spontaneous origin. Upon this point we would observe, that by violent and protracted retching a person may sometimes become jaundiced, a circumstance not unlikely to occur in cases of poisoning. The stomach, diaphragm, and abdominal muscles are, under such repeated efforts, very apt to be ren-

(*a*) See the case of *Mr. Robert Turner*, poisoned by *Eliz. Fenning*, as related by *Mr. Marshall.*

(*b*) See *Baillie's* Morbid Anatomy.

dered eminently irritable, so that at each effort of the former to discharge its contents, the latter will frequently be simultaneously thrown into strong spasmodic contractions, and the liver, together with the gall-bladder, will be suddenly caught, and, as it were, tightly squeezed in a powerful press, in consequence of which the bile will regurgitate, and be carried into the *venæ cavæ;* for *Haller* has shewn with what facility a subtle injection, when thrown into the hepatic duct, will escape by the hepatic veins; upon which *Dr. Saunders* has made the following remark, "I know this to be a fact, for I have ascertained by experiment, that water, injected in the same direction, will return by the veins in a full stream, although very little force is used."

The fact of the bile becoming, under certain circumstances, highly acrid and deleterious, has been seized by the humoral pathologist as a powerful argument in support of his doctrines. Amongst the more distinguished authors who have fully treated this subject, and maintained that our secretions may thus become acrid poisons, we have *Galen* (*a*), *Aretæus* (*b*), *Fernelius* (*c*), *Morgagni* (*d*), *Hebenstreit* (*e*), *Hilchen* (*f*), *Hoffman* (*g*), *Baumer* (*h*), *Belloc* (*i*), *Alibert* (*k*), *Foderé* (*l*), *Mahon* (*m*), *De la Mettrie* (*n*),

(*a*) Opera Omnia Ch. iv, p. 34.
(*b*) De Causis et Signis. Lib. 1, c. 7.
(*c*) De Abdit. rerum Causis. Lib. ii, c. 15.
(*d*) De Sedibus, &c. Epist. 59, n. 16.
(*e*) Anthropolog: Forens. p. 523.
(*f*) De Signis Veneni dati Diagnosticis, n. 8.
(*g*) M. R. S. T. iv, p. 3, c. 8.
(*h*) Med. Forens. p. 169.
(*i*) Cours de Med. Leg. p. 248.
(*k*) Nouveau Ellem. de Therapeutiq. T. 1, p. 408.
(*l*) Med. Leg. T. 2, p. 225.
(*m*) Med. Leg. T. ii, p. 260.
(*n*) Œuvres de Medecine, T. 1, p. 69.

and *Tronchin* (*a*). Some of the authors above enumerated have expressed their opinions in the strongest terms; thus *Morgagni* (loco citato) "*Facile agnosco a prava ipsa corporis dispositione internum aliquando posse venenum gigni;*" and *Hebenstreit* observes, "*Possunt omnino in corpore venena nasci, atque ipsi humores vitales vim vasa sua destruendi sæpe acquirunt.*(*b*)" *Hilchen*, after attempting to establish a diagnosis between the effects of poison, and those arising from a morbid degeneracy of the fluids, exclaims, apparently in despair, "*Inquilinos corruptosque humani corporis humores, eum acrimoniæ gradum, eamque corrodendi vim acquirere posse, quæ eosdem edat effectus, quos venena corrosiva sistunt, eamdem sordium vomitu rejectarum putrilaginem, fœtorem, haud dissimilem, et acerrimam, et pelves arrodentem acrimoniam certum est.*" And *Plouquet*, after describing all the phenomena of poisoning, concludes by acknowledging "*Probe autem notandum hæc omnia etiam ex aliis statibus morbosis nasci posse.*" *De la Mettrie* also has observed upon this question, "*Il est prouvé que la bile se peut changer dans nos corps en espece d'Arsenic!*" Our own countryman, *Dr. Currie* (*c*), has furnished the public with an opinion upon the subject under discussion, and he states his belief that, under a peculiar state of irritation, the biliary organs may secrete a bile of so very acrid a nature as to excite an almost immediately fatal impression upon the alimentary canal, especially when suddenly effused, and in a highly concentrated form.

(*a*) De Cholica Pictonum, p. 37.

(*b*) See also *Sloane MSS.* Brit. Mus. 330: 9135. "*Venenum potest generari in corpore.*"

(*c*) Observations on Apparent Death from Drowning, &c. by *James Currie*, M.D. p. 156.

We have deemed it right to adduce these various authorities, in relation to the important question before us, still, however, reserving our opinion, that the physician will on such occasions, by means of the subsidiary sources of discrimination above enumerated, generally be enabled to form a diagnosis (*a*) which, although it may not amount to certainty, must be considered as capable of increasing the weight of the general mass of circumstantial evidence.

As the medical treatment to be adopted in cases of acute disease, or poisoning, can hardly be considered a subject of Medical Jurisprudence, we should have passed it over in silence, did not the evidence delivered upon the trial of Donnall imperiously call upon us for some animadversion; and we feel it our painful duty upon this occasion to observe, that the whole tenor of the medical defence displayed a very unbecoming contest; the witnesses conducted themselves like advocates, raising doubts, and defending their positions with a pertinacity that belongs to those who seek triumph rather than truth.

In the cure of cholera the experience of the physicians of all ages wholly concurs. In the commencement of the disease the evacuation of the redundant bile is to be favoured by the plentiful exhibition of mild diluents, and after the redundant bile has been thus eliminated, or when the spasmodic affections of the alimentary canal become dangerously violent, opiates, in sufficiently large doses, but in small bulk, may be administered. To employ evacuants, as *Sy-*

(*a*) We are informed by *Tortosa* (Istituzioni di Med. For. vol. ii, p. 62) that a work has been published by a celebrated physician of Verona, Rotario, in which the author attempts to establish a diagnosis by which these symptoms may be distinguished. (Opere Med. p. 116.) We have not been so fortunate as to obtain a sight of this work.

denham quaintly observes, "is to increase the disturbance, and as it were, to endeavour to quench fire by oil; and on the other hand, to commence with opiates is shutting up the enemy in the bowels." Under such authority, we presume, one of the witnesses in the defence of Donnall, felt justified in condemning the practice of the respectable physician who attended the deceased (*Appendix*, *p.* 304); but we here see a witness assuming as a fact, what was never proved in evidence, and then deducing conclusions from it. *Dr. Edwards* informed the court that "there were no symptoms of cholera morbus when *he* saw Mrs. Downing; but from what *he* heard of her complaint, he imagined that there was something offensive either in the stomach or bowels, which ought to be evacuated." (*Ibid. p.* 286.)

Nor are the symptoms produced by the operation of narcotic poisons so distinct as to escape the possibility of being confounded with those of spontaneous disease. They may, for instance, simulate those of apoplexy, or epilepsy; but the history of the case, the odour of the breath, and the subsequent examination of the body after death, will generally clear up the difficulties which may at first present themselves. But we shall have occasion to consider this subject hereafter; the difficulties of the case are well illustrated by the evidence on the trial of *Donellan*, for the murder of *Sir Theodosius Boughton*, with laurel water, for which see *Appendix*, *p.* 243.

Before we quit the subject which involves the consideration of our fluids degenerating, under particular circumstances, into poisons, we may just notice the opinion of some foreign chemists, that in certain dis-

eases the *Prussic acid* (*a*) is generated in some of the fluids of the animal body. We are not inclined to accede to this proposition, because during life we do not think the chemical decompositions, known to be necessary for the production of this substance, can ever take place. At all events, it must be preceded by a state of the system which would necessarily prevent the chance of any medico-judicial fallacy.

Q. II. *Whether organic lesions, similar to those produced by poisoning, may not occasionally result from natural causes?*

In entertaining this question, we are prepared to meet with numerous alledged difficulties; but as many of them appear to have arisen, rather from the ignorance or carelessness of the operator, than from the natural obscurity of the subject itself, we are inclined to hope that by getting rid of the former source of fallacy, we shall be enabled to examine with some satisfaction and advantage, those which, in a

(*a*) Those who are desirous of becoming farther acquainted with the history of this opinion may consult the "*Recherches et Considerations Medicales, sur l'acide Hydro-cyanique, son radical, ses composés, et ses antidotes,*" par *J Coullon*, D. M. 1 vol. 8vo. 1819. *Dr. Granville* has also in his Treatise on Hydrocyanic acid (edit. 2d 1820) alluded to this opinion, and to the different authors who have supported it, p. 24. The reader will also find a case by *Fourcroy*, (Annales de Chimie, tom. 1, p. 66) of a woman, of about thirty years of age, who in consequence of protracted grief, laboured under a nervous and melancholic affection; she became extremely emaciated, and her livid paleness, and universal langour seemed to indicate a depressed state of vitality, and a decomposition of the animal fluids; after a few days she was seized with faintings and convulsions, which were followed by the discharge of drops of blood from the edge of the eye-lids, the nostrils, and the ears. The linen with which the blood was wiped was marked with spots of a beautiful blue. Fourcroy examined this matter, and concluded that the blood contained Prussiate of iron.

greater or less degree, will be liable to baffle the researches of the more experienced anatomist.

Such are the changes which an animal body undergoes after death, that unless the anatomist be intimately acquainted with their nature and extent, it is impossible that he should be able to derive any safe conclusions from his dissection; thus, said *Mr. John Hunter*, we may see appearances which are natural, and may suppose them to have arisen from disease; we may see diseased parts, and suppose them to be in a natural state, and we may suppose a circumstance to have existed before death, which was, in reality, a consequence of it; or we may imagine it to be a natural change after death, when it was truly a disease of the living body. It is not difficult, therefore, to perceive, how a person in such a state of ignorance must blunder, when he attempts to connect the appearances in the dead body, with the symptoms that were observed during life; and indeed it may be safely asserted, that the great utility of anatomical inspections depends upon the accuracy, judgment, and sagacity with which such comparisons are made. In our chapter, on the art of conducting dissections, we have endeavoured to point out each fallacy which is likely to present itself to the inexperienced anatomist, we shall therefore confine ourselves, on the present occasion, to the consideration of those points whose obscurity must be admitted to belong intrinsically to the subject, and to be wholly independent of the ignorance or skill of the dissector.

Amongst the signs of the action of poison on the human body, disclosed by the light of dissection, the separation of the villous coat of the stomach has been generally considered the most certain criterion. *Hebenstreit*, whose opinion has been adopted by *Mahon*,

and many other forensic physicians, has delivered his unreserved judgment upon the question, in the following emphatic sentence. "*Præterea sola atque infallibilis deglutiti veneni nota est, separata et veluti decorticata simulque cruenta interna ventriculi tunica: nam separatio ista supponit applicatam superficiei internæ ventriculi materiam fervidam, igni similem, quæ tunicam istam a substrata solvit vasculari nervea.*"(*a*) In opposition to such an opinion, it is our duty to state that several cases stand recorded (*b*) in which the detachment of the villous coat of the stomach and intestines has taken place, without the slightest ground to suspect the administration of poison, while many vegetable poisons destroy life without occasioning any inflammation in the *primæ viæ*, and consequently leave no traces of disorganization. But there still remains another source of fallacy connected with the present question which demands a full and impartial inquiry, viz. that the gastric juice, by its action upon the dead stomach, can occasion such changes in structure, as may be mistaken for the effects of a corrosive poison; these changes are according to circumstances liable to vary in every possible degree of intensity, from the slight erosion of the interior villous coat of the stomach, as displayed by the smooth, thin, and more transparent condition of that viscus, to the destruction of all its membranes, and the production of large perforations in its great extremity. This phenomenon, the nature of which was first explained by *Mr. John Hunter* (*c*), depends upon the gastric juice, which the stomach secreted

(*a*) Anthropolog. Forens. p. 526.

(*b*) Edinburgh Medical Essays.

(*c*) Phil. Trans. A.D. 1772, "*On the Digestion of the Stomach after Death*," by *John Hunter*, F. R.S. and Surgeon to St. George's Hospital.

during life, becoming its solvent after death. Amongst the endless proofs which the history of the animal economy affords of that universal law by which chemical and vital forces are wisely preserved in a state of perpetual hostility, there is no illustration more striking and satisfactory, than that which is furnished by the phenomenon in question. If animals, or parts of animals, while possessed of the living principle, be taken into the stomach, they are not in the least affected by the solvent powers of its juices; thence it is that we so constantly find animals of various kinds living in the stomach, or even being hatched and bred there; but no sooner do these animals lose the living principle, than they become subject to the digestive powers of the stomach, and are accordingly dissolved, and assimilated. If it were possible, says *Mr. Hunter*, for a man's hand to be introduced into the stomach of a living animal, and kept there for some considerable time, it would be found that the dissolvent powers of the stomach could produce no impression upon it; but if the same hand were separated from the body, and introduced into the same stomach, we should then find that this organ would immediately act upon it. *Spallanzani*, with a patience that almost wearies his readers, made many attempts at dissolving the stomach by its own juice, but succeeded satisfactorily in none; he proved, however, two important facts, *first*, that the process of digestion, or more correctly speaking, of solution, continues after death; and *secondly*, that the stomach itself is digestible. The truth of the first he demonstrated by introducing food into the stomach, after he had killed his animal; and that of the second, by giving the stomach of one dog to be devoured by another. The fact then is clearly established, that

the stomach, after death, may be dissolved by its own juice (*a*); and this may exist in its cavity, or be retained in the vessels which had secreted it. It remains for us then to examine the circumstances under which it is likely to occur, and the appearance by which it may be distinguished; and we may here be allowed to observe with an ingenious writer, (*b*) that were these points merely of a speculative nature, or were their decision a matter of mere curiosity, it would be idle to consume so much valuable time in their discussion; but when we remember that they are questions upon which the medical practitioner may be called upon to deliver a solemn opinion, in order to determine the fate of a criminal, they undoubtedly demand the highest attention of those who profess to aid the administration of Justice, by the lights of science. We have, therefore, first to inquire into *the circumstances under which this natural erosion of the stomach is known to take place.* *Mr. John Hunter* (*c*) details the history of three examples, in which the stomach was considerably perforated. Two of the men had died shortly after having their skulls fractured, and the third was a man who had been hanged, so that in each of these cases the person had been deprived of life by violence; whence *Dr. Adams* (*d*) inferred, that *Mr. Hunter* li-

(*a*) This phenomenon is frequently exhibited, in a very satisfactory manner, by inferior animals who die suddenly. *Mr. Hunter* noticed it particularly in fish.

(*b*) We allude to a highly interesting paper, to which we shall have frequent occasion to refer in the progress of the present inquiry, entitled "*Observations on the Digestion of the Stomach after Death,*" by *Allan Burns*, Lecturer on Anatomy and Surgery in Glasgow. Edinburgh Med. and Surg. Journ. for April, 1810.

(*c*) *Hunter's* Observations on Digestion, p. 185.

(*d*) *Adams's* Observations on Morbid Poisons, edit. 2, p. 30, where he says "but for this purpose, *Mr. Hunter* saw that the animal must be

mited the action of the gastric juice on the stomach to such as died from violent and sudden causes; and many physiologists have, accordingly, supposed that solution of the coats of the stomach never takes place, except where the person has died suddenly; this, however, is an inference, as *Mr. Burns* (*a*) has very justly observed, "by no means warranted by the general tenour of *Mr. Hunter's* essay," indeed he expressly states, that "there are few dead bodies in which the stomach is not, *at its great end*, in some degree digested;" "and any one," continues *Mr. Hunter*, "who is acquainted with the art of dissection, can easily trace the gradations from the smallest to the greatest." The consideration of the vast importance of this fact, and frequent opportunities of investigating the subject, induced *Mr. Burns* to collect the observations which he had made during the dissection of those bodies in which he found the stomach digested; and these observations, he informs us, have led him to conclude, that the phenomenon in question is neither so rare in its occurrence as some have imagined, nor confined to such subjects as had been, previous to death, in a healthy condition; they have also convinced him, that other parts of the stomach, besides the large end, may be occasionally acted on by the gastric juice. "That the digestion of the coats of the stomach after death is not a very rare occurrence, I think myself authorised to

in health immediately before death, otherwise neither the quantity nor quality of the secretion would be equal to the purpose; he was confirmed in this by the instances in which he saw the stomach digested; both were men who had died from a violent death; both had been previously in sufficient health to eat a hearty meal. The fair inference from these was, that when men die of disease, the appetite usually ceases, and probably the secretion of the gastric juice also."

(*a*) *Burns*, loco citato.

infer, from my having examined nine bodies in which the solution had proceeded to such an extent as to have made holes of considerable size through that viscus; and, besides these nine instances in which the digestion of part of the stomach was complete, I have had occasion to see, in opening this viscus, various degrees of dissolution of its villous coat." (*a*)

In three of the instances alluded to by *Mr. Burns*, the patients had been worn out by debilitating diseases; and they were emaciated and anasarcous. That the solution of the coats of the stomach in these cases was properly attributed to the gastric juice is very satisfactorily shewn by the relation of the following instructive dissection. "I had occasion," says *Mr. Burns*, "two days after death, to open the body of a very emaciated and anasarcous young girl, who had died from scrofulous enlargement of the mesenteric glands. On raising the coverings of the abdomen, the stomach, which was empty, presented itself to view, *with its front dissolved.* (*b*) The aperture was of an oblong shape, about two inches in its long diameter, and an inch in its short, with tender, flocculent, and pulpy edges. This I demonstrated to the pupils attending my class; and I especially called their attention to the fact, that the liver, which was in contact with the hole, had no impression made on it. Having proceeded thus far, I placed all the parts

(*a*) "It will generally be found that, where the coats of the stomach are softened by the gastric juice, the vessels are unable to resist the force of the syringe in injecting the body. In such subjects, therefore, we find the cavity of the stomach filled with wax, and we likewise see masses of it collected between the coats of the viscus."

(*b*) Mark this circumstance, for we shall have occasion to revert to it, when we come to consider *the part* of the stomach which undergeos solution from the action of the gastric juice.

as they had been, stitched up the abdomen, and laid the body aside in a cold situation for two days. Then I opened it again, in presence of the same gentlemen, and we found that, now, *the liver, where it lay over the dissolved part of the stomach, was pulpy; its peritoneal coat was completely dissolved, and its substance was tender to a considerable depth.* At this time the other parts of the liver were equally solid as before, and as yet every part of the subject was free from putrefaction; *the posterior face of the stomach, opposite to the hole, was dissolved, all except the peritoneal coat, at least the internal coats were rendered pulpy and glutinous; the peritoneal covering had become spongy and more transparent than it ought to have been.*" These facts, in addition to the many other important conclusions to which they will give rise, admonish us, that in judicial investigations into the cause of dissolution of the coats of the stomach, *the appearances will vary, according to the period after death at which the body is examined.* But the most satisfactory case which has been reported, in proof that the *post mortem* solution of the stomach may occur after a lingering disease, is that just published by *Dr. Haviland*, (*a*) where the patient died of fever after an illness of 22 days; when upon opening the body about 12 hours after death, the following appearances were noticed: "On raising the stomach and examining the little omentum, we were surprised by the appearance of a dark-coloured fluid, which seemed to escape from the former viscus. A most careful search was now made, and a large opening

(*a*) A case of extensive solution of the Stomach by the Gastric fluids, after Death. By *John Haviland*, M. D. Regius Professor of Physic in the University of Cambridge. Transactions of the Cambridge Philosophical Society, vol. 1, part ii, p. 287.

was perceived in the stomach on the upper and back part, near the cardia. The stomach was then detached, with a portion of the œsophagus and duodenum, when a large perforation of the diaphragm came into view, in the muscular part, corresponding precisely to, and communicating with, the hole in the stomach; so that a portion of the contents of the latter organ had escaped into the cavity of the chest. This part of the diaphragm was next removed. A careful examination of the other abdominal and thoracic viscera did not lead to the detection of the slightest diseased appearance. There was no where the smallest evidence of previous inflammation, no adhesions or ulcerations of any part of the viscera. The fluid which had escaped appeared to be nothing more than the contents of the stomach, of which the wine and water (*a*) formed a part, and probably gave it its dark colour. The stomach, on being examined after its removal from the body, afforded the following observations. The mucous membrane appeared to be more red and vascular than usual throughout its whole extent, and, here and there, were small spots of what seemed to be extravasated blood, lying below the mucous coat—for these spots were not to be washed off, nor to be removed by the edge of the scalpel. There were two holes in the stomach, the larger very near to the cardiac end of the small curvature, and on the posterior surface: this was more than an inch in length, and about half that breadth; the other not far from the former, also on the posterior surface, about the size of a sixpence. The edges of these holes were smooth, well defined, and slightly

(*a*) He had taken, at intervals, a small quantity of port wine and water.

elevated. The coats of the stomach were thin in many other spots, and in one in particular nothing was left but the peritoneum, the mucous and muscular coats being entirely destroyed. The hole in the diaphragm was through the muscular portion, where it is of considerable thickness, and was large enough to admit the end of the finger. There was no appearance of ulceration or of pus adhering to the edges of this perforation of the diaphragm." We have extracted a full account of this dissection, as the case is in itself truly interesting. The symptoms of the patient had been carefully watched, and no pain, or uneasiness was ever heard of, throughout the whole course of the disease, except in the head.

The powers of the stomach, as it would appear from the report, had suddenly revived at about twelve hours before his death, for "he asked for food, and swallowed a few spoonsfull of calves'-foot jelly with apparent relish." May we not then conclude by observing, that the facts above related very satisfactorily corrobrate the truth of the corollary deduced by *Mr. Burns*, "that the digestion of the coats of the stomach may take place under two very different conditions of the body; that although such solution is most frequent in those who have been suddenly deprived of life, when in full health, that it is not confined to those alone, but does, under certain circumstances, occur in those who have died from lingering diseases."

Having then shewn under what circumstances the phenomenon in question may take place, we shall now proceed to describe more minutely the appearances which it may assume, and *first, with respect to the part of the stomach, more usually acted upon by the gastric solvent. Mr. Hunter* thought, that digestion

of the stomach after death was occasioned by that portion of the gastric juice *contained in the cavity* of the stomach; consequently it followed, as a fair inference from this doctrine, that the coats of this viscus will only be acted on at that part on which the contents of the stomach rested. In *Mr. Hunter's* cases, the great end of the stomach, which in the supine position of the body is the most depending part of this viscus, was found to be chiefly affected; a fact which tended to corroborate and support his opinion, and to render his conjecture extremely probable. Other anatomists, however, have discovered instances of solution of other parts of the stomach than the great end, indeed we have already described such an instance in the case of the emaciated and anasarcous girl examined by *Mr. Burns*, where the situation of the aperture was different from what it had been in any of *Mr. Hunter's* cases. It was seated *on the fore-part* of the stomach, about an inch distant from the pylorus, and mid-way between the smaller and greater curvatures of this viscus; at a part of the stomach with which the gastric juice *could not have come into contact*, as the body had constantly been in the supine posture. "If then," asks *Mr. Burns*, "the stomach was not acted on by the fluid contained in its cavity, how came it to be dissolved?" To us we confess his solution of the problem appears sensible and satisfactory. "We cannot, with propriety, ascribe the digestion of the stomach, in every case, to the gastric juice which has been *poured into the cavity* of that viscus; we are more properly in some instances to refer it to the action of the fluid *retained in the vessels* which had secreted it. If this be admitted as a correct explanation of the fact, we shall cease to have any difficulty in accounting for

the dissolution of other parts of this viscus besides the large end. We shall learn that the part acted on must vary, according to the place of the stomach where the gastric juice is retained in the apparatus which secreted it, and thus we shall be enabled to explain some cases, which, at present, seem to be in opposition to the observation of *Mr. Hunter.*

With respect to the appearances, which such erosions assume, some difference of opinion has also unfortunately existed. *Mr. Hunter* has asserted that "there are very few dead bodies, in which the stomach is not, *at its great end*, in some degree digested; and the anatomist," says he, "who is acquainted with dissections can easily trace the gradations from the smallest to the greatest. To be sensible of this effect, nothing more is necessary than to compare the inner surface of the great end of the stomach, with any other part of the inner surface; what is sound will appear soft, spongy, and granulated, and without distinct blood-vessels, opaque, and thick, while the other will appear smooth, thin, and more transparent, and the vessels will be seen ramifying in its surface; and upon squeezing the blood which they contain, from the larger to the smaller branches, it will be found to pass out at the digested ends of the vessels, and appear like drops on the inner surface." This condition, however, of the vessels does not invariably accompany such solution. In three of the subjects dissected by *Mr. Burns*, there was no appearance of vessels ramifying on the coats of the stomach. To account for the absence of this vascular appearance several explanations have been attempted; "but we are not," says *Mr. Burns*, "to regard the cause of this deviation from *Mr. Hunter's* description, as depending upon the particu-

lar part of the stomach acted on in the different cases; neither are we to imagine that the stage of the process at which we examine the body will assist us in this investigation; we are rather to obtain an explanation of this fact, from contemplating the difference of condition of the different individuals at the time of death; the subjects, whose cases are detailed by *Mr. Hunter*, were persons cut off by violence, in the plenitude of health, their stomachs at the time excited by the stimulus of food to vigorous action, and the process of digestion at the instant of death going on briskly, circumstances under which it is reasonable to infer that all the blood-vessels would be filled with blood, which it is evident, from the nature of the causes depriving them of life, would be detained in the veins. This being the state of his subjects at the moment of death, we shall not wonder that, when he afterwards opened the bodies, he could squeeze the blood from the digested ends of the vessels." This is certainly an ingenious explanation, and receives considerable support from the important fact of the stomach presenting a very high degree of vascularity, in cases of sudden death, as exemplified by *Dr. Yelloly* (*a*) in his account of the appearances found in the stomachs of several executed criminals soon after they had undergone the sentence of the law. So also has dissection disclosed the same phenomena, in those cases where life has been suddenly extinguished by a blow on the region of the stomach; inflammation, in such instances, is necessarily out of the question, for death is immediate; the red and inflammed appearance therefore of the stomach can alone be accounted for by regarding it as the effect of the sudden cessation of the heart, producing an accu-

(*a*) Medico-Chirurgical Transactions, vol. iv.

mulation of the blood in the extreme arterial branches. But what shall we say of *Dr. Haviland's* case? so far from the patient dying suddenly, and in the plenitude of health, he expired after a lingering illness of three weeks, and yet, upon dissection, the stomach was found *highly vascular.* This is in direct opposition to the theory of *Mr. Burns*, and, we must confess, is not a little embarrassing. Where the gastric solution has proceeded so far as to produce perforations in its coats, *Mr. Hunter* states that, "the contents of the stomach are generally found loose in the cavity of the abdomen, about the spleen and diaphragm; and that in many subjects this digestive power extends much farther than through the stomach. I have often found," says he "that after it had dissolved the stomach at the usual place, the contents had come into contact with the spleen and diaphragm, and had partly dissolved the spleen, &c." With respect to the appearance of the gastric perforations, *Mr. Hunter* characterises them as having "their edges apparently half dissolved, very much resembling that kind of dissolution which fleshy parts undergo when half digested in a living stomach, viz. pulpy, tender, and ragged."

As certain corrosive poisons will occasionally produce such organic lesions in the stomach, as lead to perforations in its membranes, a question naturally arises, *how are we to distinguish such disorganizations, produced by causes acting during life, from those which result from solution after death?* To this we may at once return a general answer, that in a judicial investigation, we ought not to attribute erosion of the stomach to poison, except it be accompanied by evident marks of previous inflammation and reaction, or with gangrenous appearances; unless indeed the poi-

sonous substance be found in the stomach, or the symptoms, previous to death, be characteristic and satisfactory. It has been stated that the edges of the natural perforation are "pulpy, tender, and ragged," whereas those produced by the caustic action of a poison will generally be found well defined, and of the same thickness as any other part of the stomach. But let it be remembered, that, after all, it is upon the detection of poisonous matter in the stomach, that the prudent physician will place his great reliance. We have thus offered a review of the different opinions which have been entertained upon this important question, and in conclusion we may observe, that there will necessarily exist in each particular case, circumstances which no general views can comprehend, and upon which the practitioner must exercise his judgment and discretion. It is not our intention at present to enter fully into the several questions which were raised on the memorable trial of *Charles Angus* for the murder of *Margaret Burns*, but as we have already very frequently alluded to the medical evidence delivered on this occasion, and as we shall hereafter be called upon to notice some of its more striking features, we have subjoined a report of the trial, and of the unhappy and ill-conducted controversy to which it has given origin. (*a*) Whether

(*a*) 1. "The trial of *Charles Angus*, *Esq.* for the murder of *Margaret Burns*, taken in short hand by *William Jones*, jun. 8vo." Liverpool, pp. 1808, 288. Also

2. "A vindication of the opinions delivered in evidence by the medical witnesses for the crown, on a late trial at Lancaster for murder, 8vo. 1803.

3. "Remarks on a late publication, entitled "A Vindication of the Opinions delivered in Evidence by the Medical witnesses for the Crown, on a late trial at Lancaster." By *James Carson*, *M.D.*

4. "An Exposure of some of the false statements contained in *Dr. Carson's* pamphlet, entitled 'Remarks, &c." in a letter to that gentleman, by *James Dawson*, Surgeon."

the holes in the stomach were the effects of corrosive poison or of that solvent action after death, which we have just endeavoured to explain, must remain a

The suspicion against the prisoner, *Charles Angus*, was, that he had endeavoured to procure a premature delivery, or abortion, by means of an instrument resembling a long trochar, and that he had administered, or been privy to the administration of certain drugs, which had occasioned such effects upon the stomach of the deceased, as in the end produced her death. The prisoner was a retired merchant, with two or three children, with whom the deceased had lived as housekeeper and governess. It appeared in evidence that improper familiarities had been noticed between them, and that Miss *Burns* had, for some time, appeared out of health, and that her abdomen was much increased in size at the period when she was attacked with the symptoms which preceded her death, and which, as we learn from the witnesses on the trial, presented the following history.

The deceased was seen by the servants of the family at about six o'clock, on Wednesday morning, the 23d of March, 1808, at which time she was in her usual state of health; but replied to one of them, who remarked her having risen earlier than usual, that she could not sleep. She was next seen by the servants at a quarter before nine, sitting at breakfast with *Mr. Angus*, but apparently very ill; after breakfast she was lying on a sofa complaining of a pain in her bowels, but she was not then sick. On moving about afterwards, she held by the chair, as if from pain, and about an hour and a half after breakfast, she ordered some water gruel, of which she drank nearly three quarts in the course of the day, being very thirsy, and in considerable pain, and so sick as to reject the gruel almost as soon as it was taken. The matter vomited was described by the house-maid as being, at first, very black, but becoming, towards the last, of a green colour; the kitchen maid, however, described it as being in the first instance of a green colour, with yellow pieces in it resembling the inside of an orange, or the yolk of an egg, and as turning blacker after it ceased to be green. While thus retching, *Miss Burns* observed to the house-maid, "Oh, Betty, what bile comes off my stomach! I wish I had taken an emetic long since." On the servants going to bed that night, she seemed very poorly, but did not complain to them.

On Thursday morning, at six o'clock, she was lying, as she had been left the night before, on the sofa, with pillows under her head; she complained that she was very thirsty; said she was tired of gruel, and had some water posset, and a little warm beer. She also complained that she was badly hurt to make water; but was relieved by sitting on a

matter of doubt, for the erosion in this case was so considerable, and the inflammation so slight, that it is impossible to assert that they both depended on the same cause.

sliced onion, with some boiling water poured over it. Her vomiting was now of a blacker colour, and she continued sick and vomiting all day, till towards evening, when the sickness went off, and she appeared better, and could stir more about.

On Friday morning, at four o'clock, the house-maid went into the room, and thought her much worse, as she breathed quicker than before. She was seen again at six in much the same state, and lying in the same posture on the sofa; she asked for some warm beer, which settled on her stomach, and she also took about a pint of gruel; she said that the pain had left her. Her vomiting had ceased, but was succeeded by a "*law*," which continued all the morning. A little before ten, the house-maid was sent out for some Madeira, *Miss Burns* having expressed a wish for some. Between the hours of ten and eleven, the kitchen maid was in the room, and received orders about dinner; and *Miss Burns* said she would have some barley water. On the return of the house-maid, about eleven, she went straight into the parlour, where *Miss Burns* was found lying dead in the corner, by the door, with her face against the wall, "*cowered of a lump*," her elbows upon her knees, and one foot "*crudled*" under her; *Mr. Angus*, who had nursed her throughout, sitting in an arm chair, apparently so fast asleep that he was not roused without difficulty. During the whole course of her illness, she did not go to bed, but remained in the parlour, generally lying on a sofa. She refused to have medical assistance; but *Mr. Angus* said that he had given her seven drops of laudanum on one night, and ten on another, and that on the morning of her death he had given her some castor oil, in spirit, but that it came up immediately.

REPORT OF THE DISSECTION.

On Sunday the 27th of March, 1808, at noon, *Dr. Rutter* was desired by the Coroner of Liverpool to take with him an experienced surgeon to the house of *Mr. Charles Angus*, and there to examine the body of a young lady who had died suddenly.

The examination was made at two o'clock the same day, by *Mr. Hay*, a surgeon in Liverpool, with his apprentice, in company with *Dr. Rutter* and *Dr. Gerard*; and the following report on the subject was presented to the coroner in writing.

"On our arrival at the house, we were introduced into a parlour,

With respect to the possibility of confounding the appearances of gangrene, in the stomach, with those of putrefaction, some notice is necessary in this place;

where we found *Mr. Angus*, with some other persons to us unknown; and we delivered to him the note from the coroner as the authority under which we acted. Upon perusing it, he expressed perfect willingness that the examination should be made. We were then introduced into the room up stairs, were the body of the deceased was laid. After having removed the body, a small stain of blood was observed on the sheet of the bed on which it had laid; and the pillow was stained with a fluid which had issued from the head. The body being laid on a table, a large quantity of a thin yellowish fluid poured out from the nostrils, and was collected in vessels. No marks of external violence were discovered on the body; nor was there any appearance of commencing putrefaction. The nails of the fingers were of a bluish colour; and the veins on the external surface of the *abdomen* or belly appeared to be much enlarged. At this period we were joined by *Mr. Christian*, surgeon. On opening the *abdomen*, a considerable quantity of fluid was found to have been effused into that cavity, similar in colour and smell to that which issued from the nostrils, but more turbid. Marks of inflammation were found on the external or peritoneal coat of different portions of the small intestines; but the large intestines were free from it. The external coat of a part of the smaller curvature of the stomach was also inflamed; and a similar appearance of inflammation was observed on a small portion of the anterior edge of the liver, directly over the smaller curvature of the stomach. On raising up the stomach, an opening through its coats was found in the anterior and inferior part of its great curvature; and from this opening a considerable quantity of a thick fluid of a dark olive colour issued; of which fluid some ounces were collected and preserved. The natural structure of the coats of the stomach for a considerable space around this opening was destroyed; and they were so soft, pulpy, and tender, that they torn with the slightest touch. Around this part of the coats of the stomach, there were no traces of inflammation whatever. The stomach was then taken out of the body; and its inner surface was carefully washed; and the contents washed out were preserved. A quantity, about three ounces, of a fluid resembling that in the stomach, but not quite so thick, was also taken out of one of the small intestines, and preserved.

"On examining the womb, it was found to be very considerably enlarged, and, on its inner surface, the part to which the *Placenta*, or after-birth, had adhered, was very plainly discernible. This part was nearly circular, and occupied a space of about four inches in diameter.

and we cannot better illustrate the subject, than by introducing the marks of discrimination which are

The mouth of the womb was greatly dilated. In a word, the appearances of the womb were such as might have been expected a few hours after the birth of a child nearly full grown.

"The fluid taken out of the stomach and intestines, and cavity of the *Abdomen*, as well as that collected from the nostrils, was taken away: and, afterwards, in the course of the same day, examined, and subjected to various trials, with a view to discover the presence of such mineral substances as were likely to produce appearances or effects similar to those which were found in the stomach of the deceased. In this examination, we thought it right to request the assistance of *Dr. Bostock*. The contents of the stomach were, as has already been mentioned, of a dirty olive colour, thick, and of an acid smell. A considerable number of large globules of a dark coloured, dense, oily fluid, floated upon them; but no particular smell that we could discover. We could not discover, in the contents of the stomach, by the smell, the presence of any known vegetable substance, capable of producing deleterious effects when introduced into it. The fluid contained in the stomach deposited no sediment; nor was any but a mucous sediment found in the water with which the inner surface of the stomach was washed. Upon subjecting the contents of the stomach, in the state in which we found them, to such tests as are deemed sufficient to detect the presence of any active preparation of Mercury or Arsenic, we could not detect either of these substances. The contents of the stomach were then filtered, and subjected to the same trials, but with the same result. These trials were made at *Dr. Bostock's*, in the presence of *Dr. Gerard* and *Dr. Rutter*."

The substance of this report was afterwards delivered, in evidence, on the trial; and the following additional circumstances stated.

"The preternatural opening in the stomach was larger than a crown piece; but *Mr. Hay* thinks he may have increased it in drawing down the stomach, as it was nearly in the centre of the disorganized portion, where the coats were thin, soft, and semi-transparent. The stomach was nearly full of the fluid described, but not distended. The intestines also contained a great deal of a similar fluid; and the internal villous coat of the duodenum was slightly inflamed, while its external coat was also more inflamed than that of the other intestines."

In consequence of the suspicious circumstances attending the death of *Miss Burns*, *Charles Angus* was indicted for her murder; but, after a trial which occupied the court from eight o'clock on Friday morning, until three on Saturday, the 2d of September, 1808, the prisoner was acquitted.

considered by *Mahon* (*a*) as decisive upon such occasions. The spots in the stomach, resulting from putrefaction, says he, may be distinguished from those which have resulted from violent causes, during life, in the following manner. If the stomach retain its natural colour, and the spots are mixed with a red hue, or the ulcers have pale, or bright red edges, such have been the effect of some violent impression upon the living membrane; whereas, on the contrary, if the stomach be pale, livid, or green, and exhibit spots of the same colour, but of rather a deeper hue, we may safely conclude that they are the genuine phenomena of putrefaction. See the interesting account of the dissection of *William Mitchell*, p. 191.

The medical defence, conducted by *Dr. Carson*, and which savoured more of the ingenuity of the forensic pleader, than the justice of the honest inquirer after truth, rested upon the following grounds, viz. 1, The appearances of the stomach upon dissection are to be reconciled upon the supposition of the dissolution of its coats having taken place, *after death*, in consequence of the action of the gastric fluid. 2. The symptoms which preceded death were not such as accompany corrosive poisoning. 3, No poisonous substance was detected in the body. 4. The appearance of the uterus does not justify the conclusion that a delivery had recently taken plaee; such a dilated state of the organ, had it lately parted with a placenta, must have occasioned death by hemorrhage, or it must have been found gorged with coagulated blood. 5. The appearances may be reconciled by supposing that an expulsion of hydatids had taken place.

We must not omit to state, that in consequence of the intense interest excited by this trial, the ovaria were subsequently examined, when a *corpus luteum* was discovered.

We cannot conclude this account without expressing a regret that several important sources of information should have been neglected. The omitting to inspect the appendages of the uterus, to examine the œsophagus, the chest, and the head, and to analyse the membranes of the stomach, are instances of inattention, for which it is not easy to find an excuse. May they furnish a salutary lesson for future anatomists.

(*a*) Med. Leg. vol. ii, p. 315.

Q. 3. *Whether the rapid progress of putrefaction, in the body, generally, or in any particular part, is to be considered as affording presumptive evidence, in support of an accusation of poisoning?*

There are few opinions more popular than that which considers the speedy putrefaction of the body as the universal and never failing consequence of poisoning. To appreciate, however, the true value of such an indication, and to avoid the fallacies with which it is surrounded, it is essential to remember that the body of a person dying suddenly, and in what may be called full health, is very liable to run rapidly into a state of decomposition. As far, however, as our observations enable us to deduce any conclusion, certain vegetable poisons appear to accelerate such a change; for, very shortly after death, the body, under such circumstances, will frequently swell, become highly offensive, assume a black (*a*) appearance, and exhibit gangrenous spots on its surface. No such appearances, however, it is said, usually follow as the *specific* consequence of the fatal operation of *mineral* poisons; *Dr. Jaeger* in an Inaugural dissertation, (*b*) which deserves to be better

(*a*) This appearance is particularly mentioned by *Juvenal* as an effect of poison.

"Per famam et populum *nigros* efferre maritos."—*Sat.* i, *v.* 72.

The reader will remember, that we have already stated our opinion, that the poisons of the ancients were of a vegetable origin.

(*b*) Dissertatio Inauguralis de effectibus Arsenici in varios Organismos, nec non de Indicus quibusdam Veneficii ab Arsenico illati. Quam præside *C. F. Kielmayer* publicé defendet, Jan. 1808, Auctor *Georg: Fred: Jäeger*, Stuttgardianus. A very full analysis of this Essay was published by *Dr. Siegwart* in *Gehlen's* Chemical and Physical Journal; and which afterwards found its way into the Edinburgh Medical and Surgical Journal, no. xxv, Jan. 1811.

known, states, as the result of numerous experiments, that the putrefaction of animal bodies, poisoned by arsenic, whether buried or not, does not appear to be either unusually accelerated or retarded; and he moreover found that the generation of infusory animals, the production of larvæ and subterraneous vegetation, in and about the bodies of poisoned animals, took place as usual; and he remarked that "the immediate contact of an arsenical solution seemed, in several instances, to retard, in some degree, the putrefaction of the part to which it was applied in sufficient quantity." In the extraordinary case examined by *Metzger*, in which the largest quantity of arsenic ever, perhaps, taken into the stomach, was found after death, the body was not opened until eighteen days after dissolution, and yet, says the anatomist, "*cadaver, quod mireris, sine ullo fœtore aut putredinis signo erat, ut et absque maculis lividis, si digitorum apices excipias.* A case is also related by *Dr. Yelloly*, (*a*) in which death was occasioned by arsenic, but where not the slightest appearance of putrefaction was visible at the time of examination, which did not take place until forty-nine hours after death.

On the other hand, *Morgagni* (*b*) states that, on dissecting a female who died from Arsenic, "*facies corporis posterior, ne suris quidem et calcibus exceptis, tota erat nigra.*" And in the interesting case of *William Mitchell*, as hereafter related, the appearance of the body appears to have indicated that decomposition had proceeded with more than ordinary celerity.

The fact of accelerated, or retarded putrefaction, therefore, cannot be received with any confidence as

(*a*) Edinburgh Med. and Surg. Journal, no. xx. (*b*) Epist. lix, 3.

a collateral indication of poisoning. *Dr. Carson*, however, in the trial of *Charles Angus*, adduced the circumstance of its absence, as a negative proof that the deceased had not been poisoned; and in the celebrated Scotch trial of *Patrick Ogilvy*, and *Catharine Nairne*, (*a*) the same fact was forcibly urged in their defence.

Gaspard à Reies, (*b*) and other writers, have maintained that the discovery of *living* worms in the intestines of a person, suspected to have died from poison, ought to be received as a direct refutation of the charge. We are, however, not disposed to concur in such an opinion. With respect to the value of the indication supposed to be afforded by the circumstance of froth issuing from the mouth of the corpse, soon after death, *Mr. Hunter* has given a very satisfactory opinion, and to which we must refer the reader, see *Appendix*, p. 273.

Q. IV. *How far the absence of poison, or the inability of the chemist to detect it, in the body, or in the fluids ejected from it, is to be received as a negative to an accusation of poisoning?*

We have already stated, that of all the proofs which can be adduced by the physician, in support of

(*a*) *Patrick Ogilvy* and *Catharine Nairne* were indicted for incest, and the murder, by Arsenic, of *Thomas Ogilvy*, brother of the said *Patrick*, and husband of the said *Nairne*. This celebrated Scotch trial commenced at Edinburgh, on Monday the 12th of August at seven in the morning, and the court continued setting until about two on Tuesday morning, when the Jury being inclosed, it adjourned until Wednesday at four o'clock in the afternoon. They were both found guilty. After several respites *Ogilvy* was executed. *Nairne* escaped from prison, and was never afterwards heard of.

(*b*) Camp: Elys:

a charge of murder by poison, no one can be put in competition with that which arises from the discovery of the poisonous substance itself, in the stomach, or in the contents of the matter ejected by vomiting or purging. The law expects, therefore, that the professional witness should be prepared to state, that every experiment, calculated to detect the presence of poison, has been scrupulously and faithfully performed; and we may take this occasion to observe, that the circumstance of advanced putrefaction can rarely, in the present state of our chemical knowledge, be admitted as a satisfactory plea for not having proceeded to an anatomical inspection, as preliminary to chemical inquiry; and, as to the danger of such dissections, *Dr. Gordon Smith* has very truly observed, "that much is placed to this account which belongs merely to disgust." Had an examination of the body taken place in the case of *Ogilvy* and *Nairne*, how many doubts would have been cleared away; indeed, this omission afforded the prisoners a strong ground of defence; they complained that the informer had intentionally prevented the dissection of the body, being conscious that the suspicions he had raised, and the project he had formed for their ruin, would, by such a measure, have been totally removed and defeated. To this it was answered, that when the informer (a younger brother of the deceased) arrived, he did insist on the body being opened and examined, as soon as a physician of eminence could be present, which the prisoners did not then oppose; but that when the physician arrived on the ensuing day, he declared the body to be in such a putrid state, that no certain conclusions could be drawn from outward appearances, nor even from a dissection of the body, which, besides, could not be performed with safety

to the surgeon and attendants, and that he therefore thought proper to decline the investigation. Fortunately for the ends of justice, the circumstantial evidence of guilt was too strong to be affected by this culpable defect in the medical testimony, although it has been often asserted that the prisoners should have received the benefit of the omission by an acquittal. See *Donellan's* case in the *Appendix*, p. 243.

With respect to the mode of conducting a chemical analysis upon these occasions, we have reserved our directions, until we shall enter on the discussion of poisons individually. We have, however, in this place some remarks of a general nature to offer, to which we are desirous of drawing the attention of those, who, without much experience, may be called upon to conduct such investigations. In the first place, we are desirous of convincing him, that the processes which he must institute, for the detection of a mineral body, are by no means so elaborate and embarrassing, as a superficial view of the subject may lead him to conclude. During the progress of the present work the author has repeatedly felt the truth of the opinion which he is now expressing; for, like *Becher*, he has laid down his pen, and taken up his tests, and, by the most simple modes of manipulation, has satisfied his own mind of the extreme delicacy of the different processes which are recommended for the detection of a poisonous mineral; in short, it is very difficult to convince those whose chemical knowledge is wholly theoretical, with how little trouble, and with how much pleasure and profit, such experiments may be conducted. If such then be the perfect state at which our analytical knowledge has arrived, the reader may perhaps conclude, that *in every case of mineral poisoning the deleterious substance*

should be found, and that the inability of the chemist to detect its presence, should go far to negative the charge. Such an inference, however, is neither correct, nor philosophical, for the poison may have been absorbed, or eliminated, during life, it may have undergone chemical changes, or it may have entered into combinations, by which its characters are masked, or wholly changed. To *Dr. Bostock* the judicial physician is under many obligations, but there is no discovery for which he is more deeply indebted to him, than for that which has resulted from his satisfactory experiments, in elucidation of the present question. He has shewn, in the instance of *Corrosive Sublimate*, (*a*) that an animal may be suddenly killed by receiving a metallic poison into the stomach, and yet that the most delicate chemical re-agents may not be able to detect any portion of such poison, after death, in the contents of that viscus. *Dr. Henry*, in a letter to *Dr. Duncan*, (*b*) communicates the case of *Hannah Tomlinson*, aged twenty, who died, under the care of *Dr. Holme*, on the sixth day after a dose of *Corrosive Sublimate*. In this case, although an ounce of the mercurial salt had been swallowed, and the fluid ejected from the stomach was examined, only twelve hours afterwards, by *Drs. Henry* and *Roget*, yet not the slightest trace of the poison could be detected! More recently we have received from the pen of *Mr. Alexander Murray*, (*c*) surgeon of Alford, some highly interesting cases of poisoning by Arsenic, and which are so illustrative of the present question, as well as several others that have fallen under consideration, that no apology can be neces-

(*a*) Edinb. Med. and Surg. Journ. no. xvii.
(*b*) Ibid. no. xxvi.
(*c*) Ibid. no. lxxi, for April, 1822.

sary for introducing some account of them in this place. A family of the name of *Nicholls*, and which consisted of *William*, a robust man, aged 45, *James*, æt: 52, *Mary*, æt: 50, and *Helen*, æt: 48, breakfasted together on Sunday morning, (August 19, 1821) on porridge, consisting of milk, salt, and meal. *William* partook largely, but *James*, who perceived "a sickening taste," took less than common, while the sisters had their usual quantity. *William* was seized with sickness shortly afterwards, about 10 *a. m*, on his way to church, and then with thirst and headache; and, on his return home, between three and four in the afternoon, he was seized with vomiting, which recurred often during the next four or five days, especially on his attempting to quench his thirst. In the early part of the week, he was heard to complain of pain in his stomach, eyes, throat, breast, and arms; he was observed to void his urine frequently; and about this time, he pointed out to one of his sisters a hollow (*a*) between his breast and belly, into which according to her expression, "she could have laid her arm."

His illness had scarcely at any time confined him to bed. On the evening of Friday, the 24th of August, he rode six miles, for the purpose of consulting *Mr. Murray*, the surgeon, and reporter of the cases; on Wednesday the 22d he had taken a dose of Epsom salts which operated, and at the time *Mr. Murray* first saw him he complained of the following symptoms:—pain and heat in the region of the stomach

(*a*) *Mr. Marshall*, in his account of the symptoms of *Mr. Robert Turner*, who was poisoned by *Eliza Fenning*, states, "On examination I discovered a very remarkable irregularity of surface, occasioned by the spasmodic contractions of the muscles of the abdomen, and even of the viscera; this unevenness extended from the epigastric region to the pubes, and to the right and left hypochondrium."

and lower part of the chest; occasional uneasiness in the abdomen, and sometimes ineffectual efforts to go to stool; thirst; difficulty of breathing; heat and uneasiness of throat, with hoarseness; soreness of eyes, which had the common appearance of inflammation; shifting pains in his extremities, particularly the arms, which had not their usual strength; great restlessness; anxious expression of countenance; pulse frequent, 100—110, not strong.

A blister was applied over the stomach and lower part of the chest, and he took an opiate at bed time. On the following day, (Saturday 25th) *Mr. Murray* visited him at his own house, and found him nearly as before, except that his countenance more strongly exhibited a disturbed and anxious expression, and the redness of the eyes, and the hoarseness were increased. *Mr. Murray* also observed small roundish white accuminated prominences, on the palate and uvula, apparently as if the membrane covering the palate bones and *velum pendulum*, was detached at the parts by a whitish liquid. This day he took an ounce of castor oil, which operated in the afternoon, his illness was not observed to change during the evening, and he retired at about eight o'clock to rest. At a little past two in the morning, he rose in search of water to drink, and on returning to bed he was heard to utter a deep groan; after which he lay motionless and quiet, and very soon was found to have expired. The surgeon who saw the body, about 10 *a. m*, states that "*many bluish spots were observed on the inferior extremities. James*, *Mary*, and *Helen Mitchell* were attacked the same forenoon with their brother *William*, and with nearly similar symptoms; they were all, however, fortunate enough to recover, although a considerable period elapsed before their usual

strength returned, and in all of them a numbness of the arms, or legs, occurred, together with a loss of muscular power.

The body of *William Mitchell* was, owing to particular circumstances, not opened until the 29th of August, (3 days 8 hours after death) when the following appearances presented themselves. "The face had a natural, composed appearance; and the rigidity of the body did not appear to be different from what is common. The right ear, and corresponding side of the face, as well as the scalp, exhibited a deep clay-blue colour. On the chest and belly, several spots and streaks, some green, others blue, were observed; and the back, upon which the body lay, was from head to foot of a livid colour; while several roundish spots, of a still deeper hue, gave to the shoulders and neck a mottled appearance. The penis was much swollen and red. The scrotum also was enlarged, and of a dark blue colour.

Upon opening the abdomen, the smell was not unusually offensive, and its contents did not appear to have undergone alteration after death, but several ounces of a highly-coloured liquid were found in the cavity. The surface of the jejunum and ilium presented many purple spots, some of which were several inches in circumference. The peritoneal surface of the stomach, in a tract which extended from the cardia, and occupied, for some distance downwards, the whole circumference of that viscus, except the small curvature, was of a clear, dark red colour; and through this space dark lines, apparently veins, were observed to ramify. This appearance, perhaps, from 20 to 30 square inches in extent, was strongly marked in contrast with the natural state of the inferior extremity and small curvature. The substance

connecting the stomach to the spleen, was, as well as a small part of the transverse colon, of a red colour. The spleen was gorged with blood; the liver healthy. The duodenum, from a small distance below the pylorus, almost to its inferior extremity, and round nearly the whole intestine, was of a very dark purple colour. Upon opening the stomach, the internal surface of that part where the outward appearance, already described, existed, was found of a bright red colour, and over this lighter dots were thickly scattered (*a*), making such an appearance as might be produced by a red colour being dashed from a painter's pencil, upon a somewhat darker *ground.*

The internal coats of the duodenum were very dark coloured, with a slightly reddish hue, pulpy, thickened, and easily separated from the peritoneal covering, while in one roundish spot, of the size of a crown piece, the villous and muscular coats were entirely wanting. Red patches were observed on the inner surface of the jejunum and ilium, the shape, size, and situation of which were the same as those of the appearances already noted as occurring on the outside of these intestines. The stomach and duodenum contained about a quart of a brown, semi-opaque, thickish liquid; the jejunum and ilium were empty, and coated with a yellow viscid matter. The lungs and heart were quite healthy; but in the cavity of the thorax were ten ounces of a reddish turbid liquid, and about half that quantity in the pericardium. The pharynx was of an unusally red colour. The whole of the brain was healthy, and of firm consistence."

(*a*) Nothing can be more strikingly illustrative of the characteristic appearances which distinguish the effects of violence during life, from those which result from putrefaction as described at page 181.

Mr. Murray concludes by stating that no part of the salt and milk used on the sunday morning, was to be found after he visited the family, and that although the remainder of the meal, and also the contents of *William Mitchell's* stomach and duodenum were examined by *Drs. Henderson* and *Fraser*, of Aberdeen, as well as by *Mr. Craigie*, surgeon, who assisted in the dissection, and *Mr. Alexander Murray*, yet, "*no poisonous ingredient was detected in these substances.*"

The pathological and anatomical facts were, however, in themselves, so striking and satisfactory, that not the slightest doubt can exist as to the cause of the sufferings and death of the deceased; while, as *Mr. Murray* very justly states, the high probability, arising from the separate symptoms of each individual, is strengthened almost to certainty, by the simultaneous occurrence of these in a whole family of four persons; while no similar disease, indeed no epidemic of any kind, prevailed at that time.

We have only to add that the brother-in-law of this family was, in October, 1821, tried before the Judiciary Court at Aberdeen, for administering poison to his four relations; when the testimony given by the medical witnesses induced the judge and jury to consider the abstract act of poisoning proved. The accused afterwards confessed his guilt, and that he perpetrated the crime by means of *Arsenic*, put among the salt on the sunday morning on which the family were taken ill.

The public, and the profession, are greatly indebted to *Mr. Alexander Murray* for the details of this instructive case; and the patient attention and judgment with which he conducted the investigation, deserve the highest commendation, and afford an ex-

ample which we sincerely hope future practitioners will endeavour to follow.

Q. V. *What degree of information can be derived from administering the contents of the stomach of a person supposed to have been poisoned, to dogs, or other animals?*

It has from time immemorial been generally believed, that no proof of poisoning is more satisfactory than that which is furnished by the effects produced upon dogs, by their swallowing the contents of the stomach of persons who are supposed to have died from poison. Writers on Forensic medicine have, however, adduced several objections to the validity of such a test; some of which are undoubtedly worthy consideration, while others are the deductions of a theory which receives no support from experience. In the first place it has been stated, that substances poisonous to man, will not always occasion deleterious effects upon animals (*a*); this, to a certain extent, is undoubtedly true; some of the *Ruminantia* appear to be less sensible to the operation of narcotic plants, than carnivorous animals. *Aloes* are injurious to dogs and foxes. Oxen are said to eat the *Philandria Palustris*, which is pernicious to horses; but we are

(*a*) The author refers the reader to the first volume of his *Pharmacologia*, page 124, *note*. In addition to what he has there observed it may be stated, that many fallacies have arisen in pharmacology, from deducing conclusions respecting the effects of remedies upon inferior animals. One example will suffice.—Several substances have gained the reputation of Styptics, from the effects which have followed their application to the wounded and bleeding vessels in the extremities of the horse and ass; whereas the fact is that the blood-vessels of these animals possess a power of contraction which does not exist in those of man, and to which the cessation of the hemorrhage, fallaciously attributed to the styptic, is to be wholly attributed.

very much inclined to believe that a poison sufficiently powerful to destroy the life of a man, would if administered in the same state of concentration, destroy that also of an inferior animal. It is in smaller doses only that the difference in the action of such bodies upon various animals becomes evident and appreciable. This opinion is confirmed by numerous experiments. *Mr. John Hunter*, in his evidence (*a*) on the trial of *Donellan*, in answer to the question, whether any certain conclusion can be drawn respecting the poisonous operation of a substance upon man, from its effects upon an animal of the brute creation, replied, "*As far as my experience goes, which is not a very confined one, because I have poisoned some thousands of animals, they are very nearly the same; opium, for instance, will poison a dog similar to a man; arsenic will have very near the same effect upon a dog, as it would have, I take it for granted, upon a man; I know something of the effects of them, and I believe their operations will be nearly similar.*" If any farther confirmation of this opinion were required, how extensively and satisfactorily has it been afforded by the late experiments of *M. Orfila.* (*b*) *Mr. Hunter* also, on the memorable trial above mentioned, explained a source of fallacy which attends such experiments upon animals; he is asked "whether there are not many things which kill animals almost instantaneously, that will have no detrimental or noxious effect upon a human subject, such, for instance, as spirits?" He replies that a great deal depends upon

(*a*) See Appendix, page 272.

(*b*) Toxocologie Générale considérée, sous les Rapports de la Physiologie, de la Pathologie, et de la Medicine légale. Paris, 1815. This work has been faithfully translated into English by *John Walker*, in two volumes. London, 1817.

the manner of conducting the experiment, and that by forcing an animal to drink, the liquor often passes into the lungs. See *Appendix*, *p.* 272. *Orfila*, in his valuable work on poisons, instituted a series of experiments upon this subject, with the intention of determining the value of an experiment so generally accredited; from which he his led to conclude, 1st. That the practitioner should never attempt by force to make an animal swallow the suspected substance, nor should he put it into his food; for by such a proceeding he would not only run the hazard of losing the greatest part of it, because the animal would reject it, but the food with which it is combined might exert upon it some chemical action, or so envelope it as to protect the coats of the stomach from its contact; besides which it would, says he, happen, at least six times in ten, that a part of it would flow through the larynx into the lungs, and the animal will die of Asphyxia. 2d. The best method that can be employed, consists in detaching the œsophagus, perforating it with a small hole, introducing into it a glass funnel, and pouring the liquid into the stomach; that being done, the œsophagus is to be tied below the opening. It would, observes *M. Orfila*, be imprudent to prefer to this method, the use of an elastic gum tube adapted to a syringe, for many bite the tube, pierce it with holes, and the fluid then flows out of the mouth; besides which, syringes of tin might decompose certain poisonous fluids. The obvious objection to such a mode of administration is anticipated by this laborious experimenter with much ingenuity. It may be asserted, says he, that the animal perished from the operation of tying the œsophagus, and not from the action of the poison thus introduced into the stomach, but such an objection

has no foundation in truth, for either the suspected substance is in quantity sufficient to destroy the animal, or it is not; in the first case death will take place during the first forty-eight hours, and will be preceded by symptoms more or less severe, a phenomenon never observed in the simple ligature of the œsophagus; in the second case, the experiment will not be more conclusive, than if the œsophagus had not been tied: and the author asserts, that the operation of tying the œsophagus would not, of itself, produce during the first forty-eight hours any other symptom than a slight dejection, and that consequently all other morbid phenomena that may be observed, upon such trials, ought to be attributed to the poisonous substance. To all this we reply, that we believe, in the hands of *Orfila* who has made a thousand experiments, that such results may be satisfactory, but we feel no hesitation in declaring, that we should not place the smallest reliance upon such an experiment when conducted by a person unaccustomed to the operations of experimental physiology. If there be no other mode of employing an animal as a test for poison, but by tying his œsophagus, we must, in a judicial point of view, reject it altogether.

But there still remains another source of fallacy connected with these experiments, to which considerable importance has been attached. It has been said that the acrid humours ejected from the stomach of a person labouring under a *spontaneous* disease, may kill an animal. *Morgagni (a)* relates a very remarkable instance, in illustration of this fact. A child having died of a fever was opened, when a quantity of green bile was found in the stomach,

(*a*) De Sed. et Caus. Morb. per Anat. indag. Epist. 59, 18.

which changed the colour of the scalpel to violet; having dipped the point of the knife into this bile, two pigeons were wounded with it, and they soon died in convulsions. The bile was then mixed with some bread, and given to a cock, which also died in the same manner. From this general view of the subject before us, the forensic physician will be enabled to appreciate its just value, and to apply the indications it may furnish, in each particular case, without the risk of error. In some instances such experiments may prove nothing, in others they may afford only equivocal results, but which may add something to the general weight of circumstantial evidence; while others, again, may furnish proofs so unquestionable, as to leave no doubt upon the subject; such was the case in the instance of *Michael Whiting* (*a*), who was convicted of administering corrosive sublimate to his brothers-in-law, when it appeared in evidence that a portion of the poisoned dumpling was given to a sow, who in consequence became sick, and remained ill for several days.

We have now disposed of the several questions connected with the subject of poisoning, which must be regarded, in their forensic relations, as being of the highest importance. In considering the subjects, generally, there must necessarily remain doubts, many of which will be considerably diminished, or entirely removed, upon their application to particular cases; still, however, the nature of medical evidence upon such occasions must be frequently re-

(*a*) See the interesting trial of *Michael Whiting*, for administering poison to *George* and *Joseph Langman*, of Downham, in the Isle of Ely, at the Assizes holden at Ely on Wednesday, March 4th, 1822, before *Edward Christian, Esq.* Chief Justice of the Isle. The prisoner was convicted and executed.

garded as only sustaining high probabilities, and the professional witness may exclaim with *Hoffman* (*b*) "*Ardua sane provincia ei imponitur cui determinandæ ejusmodi quæstiones exhibentur.*"

(*a*) M. R. S. T. iv, P. iii, p. 278.

ON THE CLASSIFICATION OF POISONS.

Poisonous substances have been very differently arranged by different authors, each appearing to have adopted a classification best suited to promote the particular views and objects of his own pursuit; thus, the botanist and chemist, engaged in the examination of the physical characters by which poisons may be individually distinguished and identified, have very judiciously erected their system upon the basis of natural history. The pathologist, whose leading object is the investigation of the morbid effects which follow the administration of these agents, with equal propriety and justice prefers a classification deduced from a generalization of the symptoms they are found to occasion; while the physiologist, who seeks to ascertain through what organs, and by what mechanism they destroy life, may be reasonably expected to arrange the different poisons under divisions corresponding with the results of so interesting an inquiry.

To meet the comprehensive views of the forensic toxicologist, an arrangement would seem to be required, that should at once embrace the several objects which we have just enumerated; for the data from which the proof of poisoning is to be inferred, are, as we have often stated, highly complicated in their relations. No such classification, however, can be accomplished, and we are therefore compelled to select one which may approach the nearest to our

imaginary fabric. That which was proposed by *Fodéré*, (*a*) and adopted, with some trivial alteration in the order of succession of the classes, by *Orfila*, in his celebrated system of toxicology, although it has many defects and some errors, nevertheless merits the preference of the forensic physician; its basis is strictly pathological, and yet it distributes the different poisons, with some few and unimportannt exceptions, in an order corresponding with that of their natural history.

The first two classes, for instance, present us with substances of a mineral origin; the third and fourth, with those which are principally of a vegetable nature; and the sixth, with objects chiefly belonging to the animal kingdom. The importance of acknowledging a division, which has a reference to the three great kingdoms of Nature, is perhaps greater than the reader may anticipate; for in enumerating the various experiments to be instituted for the detection of poisons, we are, by such an arrangement, enabled to bring together a connected series of processes, nearly allied to, intimately connected with, and in some respects, mutually dependant upon each other.

The following is the arrangement of *Fodéré* as modified by *Orfila*: viz. Cl. I, *Corrosive*, or *Escharotic poisons.* Cl. II, *Astringent poisons.* Cl. III, *Acrid* or *Rubefacient poisons.* Cl. IV, *Narcotic* or *Stupefying poisons.* Cl. V, *Narotico-Acrid poisons.* And Cl. VI, *Septic* or *Putrefying poisons.*

(*a*) " Nous adoptons la division suivante, en six classes, de tous les poisons connus, et de toutes les manières possibles par lesquelles les substances vénéneuses peuvent nuire au corps humain: Poisons Septiques —Poisons Stupefians, ou Narcotiques—Poisons Narcotico-acres —Poisons Acres, ou Rubefians—Poisons Corrosifs, ou Escarotiques—Poisons Astringens.

Class 1. Corrosive or Escharotic Poisons. Such as corrode and burn the textures to which they are applied. When internally administered they give origin to the following symptoms: violent pain accompanied with a sense of heat and burning in the stomach, and throughout the whole extent of the alimentary canal; frequent vomitings, often sanguineous, and alternating with bloody diarrhœa, with or without tenesmus; the pulse hard, small, frequent, and at length imperceptible; an icy coldness of the body; cold sweats; a great anxiety and oppression at the præcordia; and hiccup. Sometimes the heat of the skin is intense, the thirst inextinguishable, and the unhappy patient is tormented with Dysuria and Ischuria, violent cramps in the extremities, and horrid convulsions, which are relieved only by death. Such are the general symptoms by which this species of poisoning is characterised; the rapidity with which the symptoms terminate their course, will depend upon the violence of the dose, and the particular species of poison which has produced them; there are, moreover, other symptoms which will be more conveniently described, when we come to speak of the effects of corrosive poisons individually. In this class are ranked the following substances. Metals. I. Arsenic—1, *Arsenious Acid*, or white oxide of Arsenic. 2. *Arsenites*, or combinations of that acid with *salifiable bases*. 3. *Arsenic Acid*. 4. *Arseniates*, or combination of the preceding acid with the bases. 5. *Sulphurets of Arsenic*, or *Orpiment* and *Realgar*. II. Mercury—1. *Corrosive Sublimate of Mercury*, or *Oxy-muriate of Mercury*. 2. *Red Oxide of Mercury*. 3. *Red Precipitate*, or *Nitric Oxide of Mercury*. 4. Other preparations of Mercury. III. Antimony—1. *Tartarized Antimony*, or *Tartar Emetic*. 2. *Oxide*

of Antimony. 3. *Antimonial Wine*. 4. *Muriate of Antimony*, or *Butter of Antimony*. IV. Copper—1. *Blue Vitriol*, or *Sulphate of Copper*. 2. *Verdegris*. 3. *Oxide of Copper*. 4. Other preparations of Copper. V. Tin—1. *Muriate of Tin*. VI. Zinc—1. *Sulphate of Zinc*, or *White Vitriol*. 2. *Oxide of Zinc*. VII. Silver—1. *Nitrate of Silver*, or *Lunar Caustic*. The Concentrated Acids—1. *Sulphuric*. 2. *Muriatic*. 3. *Nitric*. 4. *Phosphoric*, &c. Hot Liquids—1. *Boiling water*. 2. *Melted Lead*. The Caustic Alkalies—1. *Potass*. 2. *Soda*. 3. *Ammonia*. The Caustic Alkaline Earths—1. *Lime*. 2. *Baryta*. 3. *Muriate*, and *Carbonate of Baryta*. Cantharides. Phosphorus.

Class II. Astringent Poisons. They occasion a remarkable and unrelenting constriction of the great intestines, especially the colon, so as to resist the operation of the most powerful cathartic remedies. Violent cholics ensue, and partial paralysis; in the end if the dose be sufficiently large, or if small doses have been frequently repeated, they will excite inflammation of the alimentary canal, but it is not succeeded by that disorganization which generally characterises the operation of poisons, belonging to the preceding division. We rank under the present class only the preparations of Lead, viz. 1, *Acetate of Lead*, or *Sugar of Lead*; 2, *Oxides of Lead*; *Red Lead*; *Litharge*; 3, Various Saturnine impregnations.

Class III. Acrid, or Rubefacient Poisons. These poisons are known by their producing an acrid taste, more or less pungent and bitter; a burning heat, and considerable dryness in the mouth and fauces; and a constriction, more or less painful, in the throat. Acute pains are, after a short interval, experienced in the stomach and bowels, which are quickly followed by copious vomiting and purging,

and which continue, with the most painful efforts, long after the alimentary canal has been completely evacuated. A few hours after, phenomena are observed which indicate a lesion of the nervous system, such as vertigo, dilated pupils, dejection, insensibility, laborious respiration, and death. The lesions of texture, occasioned by the action of *Acrid* poisons, have the greatest analogy to those produced by *Corrosive* poisons; in fact, says *M. Orfila*, we do not hesitate to declare, that there exists a perfect identity between the alterations of the digestive canal produced by the poisons of these two classes, when introduced into the stomach." The substances included under this class belong, for the most part, to the vegetable kingdom, such as *Scammony*, *Camboge*, *Black* and *White Hellebore*, *Bryony*, *Euphorbium*, Seeds of the *Ricinus*, *Iatropa Curcas* (Indian nut), *Croton Tiglium*, *Squill*, *Aconite*, &c. &c.

Class IV. Narcotic, or Stupefying Poisons. Such as occasion stupor, drowsiness, paralysis, or apoplexy, and convulsions. They do not produce any change in the structure of parts to which they are applied. *M. Orfila* has satisfactorily ascertained that no alteration can be discovered, on dissection, in the digestive canal of persons who have swallowed any one of the poisonous substances of this class.

Class V. Narcotico-Acrid Poisons. This division, as its name implies, is intended to receive such substances as produce the united effects of those belonging to the two preceding classes, acting for instance at the same time, as narcotics and rubefacients. Amongst the articles of this class the following may be enumerated, *Belladonna*, *Stramonium*, *Tobacco*, *Foxglove*, *Hemlock*, *Nux Vomica*, *Camphor*, *Cocculus Indicus*, certain *Mushrooms*, *Alcohol*, &c. &c.

Class VI. Septic and Putrefying Poisons. By this term are included those poisons which, according to *Orfila*, "occasion a general debility, dissolution of the humours, and syncope, but which do not, in general, alter the intellectual faculties." The articles of this class belong almost entirely to the animal kingdom, with the exception perhaps of a few gaseous compounds, and the *Spurred Rye*, or *Ergot*, viz. *venomous animals; animals whose fluids have been depraved by antecedent disease; the poison of fishes; substances in a state of putridity; Spurred Rye*, or *Ergot.*

Such is the classification which, for reasons already stated, it is our intention to adopt on the present occasion. We shall, however, in an additional chapter, under the title of "*Aërial Poisons*," treat of those substances which are exclusively capable of acting upon the body through the medium of the atmosphere, or which require to be in a state of vapour, or gas, to ensure their operation.

With regard to the classification of *Fodéré* and *Orfila*, we must here observe that we follow it only conventionally, and that, while we acknowledge it as being very convenient for the consideration of poisons, in reference to their forensic relations, yet we must not be considered as insensible to its many defects and fallacies. In the first place, it has little or no reference to the enlarged views of the modern physiologist, respecting the "*modus operandi*" of poisons; nor indeed is its construction susceptible of such modifications and improvements, as can ever render its degree of perfection progressive with the advancement of science. In the next place, the classes are in many particulars ill-defined, and indistinctly, if not erroneously, divided. How questionable, for instance,

are the boundaries which separate *Corrosive* from *Acrid* poisons? even the respective species of each class are, in many instances, less allied to each other than the great divisions to which they are subordinate. As an exemplification of this fact we have only to compare the physiological actions of *Arsenic* and *Corrosive Sublimate;* the former of these substances occasions death by being absorbed, and thus acting as a vital agent, the latter, by its local action as a caustic on the textures with which it comes in contact. In the same manner, if we examine the individual actions of the different species composing the class of "*Acrid*" poisons, we shall find the same want of uniformity; thus the *Spurge-flax*, and the *Jatropa Curcas* act by occasioning a local inflammation, while the *Hellebore*, being rapidly absorbed, exerts a fatal action on the nervous system, and produces only a very slight inflammation. The class of Narcotic poisons is more absolute in its definition, and more uniform in its physiological affinities, and therefore less objectionable, than the divisions to which we have just alluded; but the propriety of the term "*Narcotico-Acrid*" may be very reasonably questioned; (*a*) even *Orfila* expresses his doubts upon the subject, "because the narcotic or sedative effects only follow the previous excitement." Some of the poisons, under this last mentioned class, are rapidly absorbed, and act, through the medium of the circulation, on the nervous system, without producing any local inflammation; whilst others, again, merely act upon the extremities of the nerves, with which

(*a*) *Belloc* surmises that where acrid poisons have been administered, narcotics may have been taken to relieve pain; and thus that a sort of combination of the symptoms of both classes may be produced.

they come in contact, and without being absorbed, occasion death by a species of sympathetic action.

These few objections, and many more might be adduced, are sufficient to demonstrate the imperfection of the classification under consideration, and which would render it wholly unavailable to the pathologist who must adopt his treatment according to the physiological action of each poison. The author has accordingly, in his "Pharmacologia" (*a*) ventured to propose an arrangement, in conformity with such views; and the following sketch of it may perhaps form a useful introduction to the general observations which it will be hereafter necessary to offer upon the "*modus operandi*" of poisons.

(*a*) PHARMACOLOGIA. Edit. 5th, vol. i, page 225, c. *Antidotes.*

A CLASSIFICATION OF THE DIFFERENT MODES BY WHICH POISONS PRODUCE THEIR EFFECTS.

1. BY ACTING THROUGH THE MEDIUM OF THE NERVES, WITHOUT BEING ABSORBED, AND WITHOUT EXCITING ANY LOCAL INFLAMMATION.

a. *By which the functions of the nervous system are destroyed.*

Narcoti-co-Acrid.
- Aconite.
- Jatropa Curcas.
- Alcohol.
- Oil of Tobacco

Narcotic.
- Essential Oil of Almonds. †
- Camphor. †
- Opium † ?

b. *By rendering the heart insensible to the stimulus of the blood.*

Infusion of Tobacco.
Upas Antiar.

II. BY ENTERING THE CIRCULATION, AND ACTING THROUGH THAT MEDIUM WITH DIFFERENT DEGREES OF FORCE, ON THE HEART, BRAIN, AND ALIMENTARY CANAL.

Corrosive.
- Arsenic.
- Emetic Tartar.
- Muriate of Baryta.

Narcotic.
- Opium.‡
- Lettuce.
- Henbane.
- Prussic acid.

Acrid.
- Hellebore.
- Savine
- Meadow Saffron.
- Squill.

Narcotico Acrid.
- DeadlyNightshade‡
- Hemlock.
- Camphor. ‡
- Cocculus Indicus.

III. BY A LOCAL ACTION ON THE MUCOUS MEMBRANE OF THE STOMACH, EXCITING A HIGH DEGREE OF INFLAMMATION.

Corrosive.
- Corrosive Sublimate.†
- Verdegris.
- Muriate and Oxide of Tin.
- Sulphate of Zinc.
- Nitrate of Silver.
- Acids.
- Alkalies.
- Cantharides. †

Acrid.
- Bryony.
- Elaterium †
- Colocynth †
- Camboge.
- Euphorbium.
- Hedge Hyssop.
- Croton Tiglium.
- Ranunculi.

† This mark denotes that the substance, against which it is placed, may also act by being absorbed.

‡ Signifies that the article has also a local action.

The preceding classification of poisons will not only furnish the practitioner with a general theorem for the administration of antidotes, but it will suggest the different modes and forms of administration of which each particular substance is susceptible; it will shew, that certain poisons may occasion death without coming into contact with any part of the alimentary canal, and that others will produce little or no effect, however extensively they may be applied to an external surface. The first class comprehends such poisons as operate, through the medium of the nerves, upon the organs immediately subservient to life; in the application of such agents it is obvious that they cannot require to be introduced into the stomach, they may convey their destructive influence by an application to any part duly supplied with nerves, and whose extremities are exposed to their action; although at the same time, it may be observed that, in general, poisons of this kind act most powerfully when internally administered, owing to the extensive sympathetic relations of this central organ over every function of the living body. The second class consists of poisons that are incapable of producing any effect, except through the medium of the circulation; whence we shall be enabled to explain and appreciate the various circumstances which may accelerate or retard their operation. Poisons of this class may be applied externally to abraded parts, or even to surfaces covered with cuticle, provided their absorption be promoted by friction; and it may be here observed, that the function of absorption is not performed with the same force in every tissue; as a general proposition it may be said to be energetic in proportion to the number of lymphatics and veins, although the late experiments of *M. Majendie* have

shewn how greatly it is influenced by the state of the circulation. (*a*) If these poisons be administered internally, they find their way into the circulating current either through the branches of the thoracic duct, or those of the *venæ portarum;* when, as if by a species of election, each substance very frequently expends its venom upon some one particular system of organs. Many of the substances arranged under this second division, have moreover a local effect upon the structure with which they first come in contact; it is thus with *Colocynth*, and some other bodies; while on the contrary, several of those poisons which are distinguished for their *local action*, are subsequently absorbed, and are thus as it were enabled to ensure their work of destruction by a double mode of operation. We shall receive ample evidence of this truth, as we proceed in the history of particular poisons. The third class comprises such agents as inflict their vengeance upon the mucous membrane of the stomach, by actual contact, and destroy, by exciting local inflammation.

MINERAL POISONS.

Under this head is included the greater proportion of those substances which are employed as the instruments of crime; for they are generally of easy access, require but little preparation, and are so destructive in small doses, and, at the same time, so little disgusting in flavour, as to furnish the assassin with the sure and secret means of destruction. Fortunately, however, for the ends of justice, such agents are pre-eminently the objects of successful analysis. In treating of the history of the individual substances derived from this

(*a*) Journal de Physiologie Experimentale, (1 er numero Janvier 1821.)

kingdom, we shall consider, 1st, their *external characters*, such as form, colour, odour, taste, specific gravity; 2d. their *chemical composition, and habitudes;* 3d. *the tests by which their presence may be recognised;* 4*th. the symptoms which they occasion;* 5*th. their physiological action;* 6*th their different modes and forms of application*; 7*th. the lesions of structure they occasion;* 8*th. the phenomena presented on dissection.*

Cl. 1. CORROSIVE POISONS.

ARSENIC.

The greek work Αρσενικον was employed by *Dioscorides*, and other writers of that period, to denote a particular mineral of a reddish colour, which *Aristotle* had already described by the name of σανδαραχη, (*a*) and his disciple *Theophrastus*, by that of αρρενικον. It was employed by the ancients both as a pigment and as a medicine, and appears to have been a compound of Sulphur, and a peculiar metal, to which the name of *Arsenic* is now exclusively applied. At what period this metal was first discovered seems very doubtful; and although a process for obtaining it is described in the Pharmacopœia of *Schroeder*, published in 1649, yet its peculiar nature was examined, for the first time by *Brandt*, in 1733.

The metal, Arsenic, is distinguished by the following properties, viz.

(*a*) The adoption of this term led to a very extraordinary error in medicine—the application of Arsenic in the form of vapour, together with the fumes of frankincense, myrrh, and other gums, in a paroxysm of Asthma! This frightful practice arose from confounding the gum Juniper, or Vernix of the Arabians, which by their medical writers was prescribed in fumigations, under the name of Sandarach, for the Σανδαραχη of the Greeks.

It has a bluish-grey colour, not unlike that of steel, and a considerable lustre; its texture is grained, and sometimes scaly; its hardness not very considerable, but its fragility is so great that it falls to pieces under a moderate blow of the hammer, and admits of being easily reduced to a very fine powder; according to *Bergman* its specific gravity is 8·31. When cold, it emits no sensible odour, but if heated, it yields a strong *alliaceous*, or garlic-like smell, which is to be considered as the most characteristic of its properties. Its point of fusion is unknown, for it is the most volatile of all the metals, and sublimes, before it melts, at the temperature of 540° Fah., and if the process be conducted slowly in close vessels, the metallic sublimate will assume a *tretrahedral* (*a*) form of crystallization; if the air be admitted, and the temperature still farther raised, it will burn with an obscure bluish flame.

Arsenic is extremely susceptible of oxidation, and, by mere exposure to the air, shortly loses its metallic lustre; and yet it may be kept under the surface of *cold* water, for any length of time without exhibiting the signs of oxidation, or solution; a covering of this fluid, or of alcohol, is therefore considered as affording the best means of preserving the metal in a state of integrity.

Arsenic is capable of combining with two proportions of oxygen, and of forming two definite compounds, which we shall hereafter consider under the title of *Arsenious* and *Arsenic* acids. The substance described by some authors as the *black oxide* of this metal would seem to be an indefinite mixture of the metal itself, and the arsenious acid.

(*a*) *Orfila.* Toxicolog. General.

Arsenic does not appear to possess any deleterious properties, but it is almost impossible to reduce the metal to powder, so as to adapt it for exhibition without its becoming oxidized. *M. Renault* therefore, in order to decide the question, had recourse to its alloys; and he found that *Mispickel* (an alloy of Arsenic and Iron), when given to the extent even of two drachms, scarcely produced any effect; a result which very satisfactorily accords with the conclusion drawn by *Bayen*, in his work on Tin, and which proves that the arsenic contained in that metal, need not excite the least alarm, since it exists in a metallic state. We have upon another occasion (*a*) observed, that the vapours characterised by an alliaceous odour are probably less noxious than the arsenical fumes which are inodorous; and that the little injury experienced by workmen who solder silver filligree with an arsenical alloy, may probably depend upon the deoxidized state of its fumes.

ARSENIOUS ACID, or WHITE OXIDE OF ARSENIC.

This is justly considered as the most fatal of all mineral poisons, and is the one more frequently selected than any other, as the instrument of assassination and suicide; while its numerous applications in medicine and the arts, by making it an article of general and indiscriminate sale, have rendered it an accidental as well as criminal source of suffering and death.

It is seldom prepared by the chemist, since it exists in a native state, and is moreover procured abundantly and economically, during the extraction of the

(*a*) Pharmacologia, edit. v, vol. 2, art. *Arsenici Oxydum.*

other metals from their ores. (*a*) In the commercial world the substance is still known by the name of *White Arsenic*; and continues to be expressed in popular language, by the simple term *Arsenic*.

It generally occurs in the form of white compact masses, opaque on their exterior surface; transparent, and presenting a vitrified aspect in the interior. Its taste is acrid and corrosive, but not to a degree corresponding with its virulence. *Specific gravity* 3·7. When reduced to powder it bears a strong resemblance to refined sugar, for which it has sometimes been fatally mistaken, and with which it has been often mingled for criminal purposes. At the temperature of 383° *Fah.* it is volatilized, and is capable of crystallizing in tetrahedrons with truncated angles, or rather in octohedrons; by a strong heat, in close vessels, it is vitrified and becomes pellucid, and acquires the specific gravity 5·000(*b*); but when exposed to the air, it shortly returns to its former appearance. *In the state of vapour it is quite inodorous*, although the contrary is positively asserted in several chemical works of high authority, and it is stated to be characterised by a smell like that of garlic; the fact is, that the *alliaceous or garlic-like smell is wholly confined to metallic arsenic in a state of vapour;* and whenever the arse-

(*a*) A very large quantity is annually prepared from the sublimate which collects in the chimneys and flues of the smelting works and burning houses in Cornwall. We have examined samples prepared according to the improved process of Dr. *Edwards*, and found them to be perfectly free from foreign admixture: a fact of much greater importance than the reader may at first imagine. Those who require farther information upon this subject may consult a paper in the first volume of the *Transactions of the Royal Geological Society of Cornwall*, by J. H. Vivian, Esq. entitled "*Observations on the processes for making the different preparations of Arsenic, which are practised in Saxony.*"

(*b*) *Bergman* ii, 286 We are, however, upon the authority of *Mr. Richard Phillips*, inclined to consider this statement of its specific gravity incorrect. He found that when transparent it did not exceed 3·715, and, when opaque, 3·260.

nious acid seems to yield such an odour, we may very confidently conclude that its decomposition has taken place, and that it has been reduced to its *metallic* state. Such a reduction will generally happen when it is projected upon ignited charcoal, or when heated in contact with those metallic bodies which readily unite with oxygen, such as *Antimony*, *Zinc*, &c. It is stated by *Orfila* and other writers, that if it be projected upon heated copper the alliaceous odour is evolved. This assertion is undoubtedly true, but the fact requires to be explained with more precision, or we may fall into an important error respecting it. The author has shewn by several experiments, already published in his *Pharmacologia*, (*a*) that the phenomenon takes place only when the copper is in a state of ignition, at which temperature its affinity for oxygen enables it to reduce the arsenious acid, and consequently to develope the metallic odour. We have ascertained by repeated experiments that if a few grains of arsenious acid be heated on a plate of copper, by means of a spirit lamp or the blow-pipe, no odour is perceptible; for, in this case, the whole of the acid will be dissipated before the copper can acquire a temperature sufficiently exalted to deoxidize, and reduce it. If the arsenious acid be heated on a plate of zinc, the smell will not be evolved until the latter metal is in the state of fusion. If, instead of the foregoing surfaces, we employ in our experiments those of gold, silver, or platina, no alliaceous smell whatever is produced, at any temperature, provided every source of fallacy be carefully avoided; but it deserves particular notice, that the author has found the flame of the spirit lamp to be in itself, capable of decomposing the arsenious acid, in

(*a*) Vol. ii, p. 86.

consequence, it is presumed, of the operation of its hydrogen; (*a*) a fact which is very likely to betray the experimenter, as in the first instance it did the author, into a belief that the arsenious acid does actually yield the odour in question.

The term Arsenious *acid* was first bestowed upon this substance by *Fourcroy*, since it was found to possess many of the essential habitudes of an acid; as for instance, that of combining with the pure alkalies to saturation. It dissolves in water; but, according to *Klaproth*, although it requires for its solution 400 parts of that fluid, at the temperature of 60° *Fah.* it requires not more than 13, at 212°; and it moreover appears that if 100 parts of water be boiled on the arsenious acid, and suffered to cool, it will retain 3 grains in solution, and deposit the remainder in crystals. This fact shews the great importance of employing boiling water in every chemical examination of substances supposed to contain arsenic. It proves also that a fatal dose of the poisonous mineral may be very easily administered in any watery vehicle, a fact which was denied on the trial of *Ogilvy* and *Nairne* (*b*) by *Dr. James Scott*, who deposed that "Arsenic would not dissolve in warm water, but almost instantly subside to the bottom of the vessel," although, at the same time, he acknowledged that "if it were put into tea with milk and sugar, and stirred about, it *might* be suspended long enough to kill those who should drink the potion." It is soluble in alcohol, and in fixed oils, the former taking up

(*a*) The chemist may satisfy himself of this fact by heating some arsenious acid on a piece of platina foil, and then alternately raising and depressing it into the blue flame of the spirit, when corresponding changes in odour will take place in the fumes.

(*b*) See page 184, Note.

two per cent. By the addition of an alkali, an *arsenite* of great solubility will result, and a solution of extreme virulence may be thus effected. With *lime-water* arsenious acid produces a white precipitate of *arsenite of lime*, but which is soluble in an excess of the acid. With *magnesia* it also forms a very soluble, and extremely active, *arsenite*.

Symptoms of Poisoning by the Arsenious Acid.

Hahnemann, in his work on Arsenic, proposes a classification of its effects founded on their relative duration and violence, and which it is our intention to adopt on the present occasion, without any other alteration than that of reversing the order of the classes.

Poisoning by Arsenic may accordingly be considered as admitting of three degrees of intensity, viz. 1st. Where the case, although attended with dangerous symptoms, does not terminate fatally. 2d. Where death does not follow until after a lapse of twenty-four hours. 3d. Where death takes place within twenty-four hours after the exhibition of the poison.

1. *Symptoms of the first and lowest degree.* In the slighter cases in which the operation of arsenic is recorded as producing poisonous effects, the symptoms were, uneasiness of the præcordia; cholics; thickness, redness, and stiffness of the palpebræ; soreness of the gums; ptyalism; itching over the surface of the body, sometimes attended with a slight eruption; restlessness; cough; head-ache; strangury, and *ardor urinæ*. Where the dose of poison has been somewhat greater, although still inadequate to the destruction of life, violent vomiting is commonly the first symptom, preceded in some instances with a sense of heat and dryness in the fauces; in such

cases where the vomiting has very shortly succeeded the ingestion of the Arsenic, and the stomach has at the same time been filled with food, the patient may owe his escape to the poison being discharged before it had time to act. *Morgagni* relates a case of poisoning at an Italian feast, where the dessert was intentionally sprinkled with Arsenic instead of flour; those who had previously eaten but little speedily perished, but those who had eaten heartily were saved by vomiting. Although in this degree of poisoning the life of the patient may be spared, yet a variety of *consecutive* symptoms may continue to harrass him for a longer or shorter period, such as indigestion, debility, partial paralysis, and epilepsy. The history (*a*) of the cases of *Mr. Turner* and his family, of Chancery lane, for the poisoning of whom *Eliza Fenning* was executed, will afford a striking illustration of this fact. The hair of the head has also been observd, in some cases, to fall off. *Dr. Male* is also of opinion that the long protracted and injudicious use of this mineral, as a medicine, will induce exostosis and caries of the bones.

2. *Symptoms of the second degree.* In this case where the patient lives two or three days, or perhaps longer, as in the case of *William Mitchell* above described (p. 190), the earliest symptoms are heat and thirst, or vomiting, and inexpressible uneasiness and anxiety, the former of which is less frequently observed than the two latter; purging, or sometimes a repeated but ineffectual desire to go to stool; wandering pains; quick, but feeble pulse; head-ache; distended and painful abdomen; priapism; towards the close of the scene the patient often becomes more tranquil and is inclined to sleep, although, in some in-

(*a*) See *Mr. Marshall's* Remarks, &c.

stances, the pains, attended with convulsions, continue to the latest moments. In general, death takes place suddenly. In cases where the effects of the poison are not immediately fatal, we must necessarily expect the occurrence of many phenomena, indicative of the re-action of the system, and which will be better illustrated by a reference to the history of individual cases, such for instance, as those of *William Mitchell*, (p. 190) and *Mr. Blandy*, (*Appendix*) than by any general description which can be given in this place. It is also worthy remark that in such cases, from the length of time, there will necessarily occur a greater opportunity for the co-operation of other contingent causes, whether they be connected with previously existing diseases, or the action of remedies; and the intelligent practitioner will not neglect to appreciate their influence in modifying the character of each particular case. There are besides symptoms highly characteristic when they do arise, but which are of comparatively rare occurrence, such as the ulcerated condition of the fundament, as in the case of *Mr. Blandy*, and the inflamed eyes and state of the mucous membranes, in that of *William Mitchell*.

3. *Symptoms of the third and highest degree.* Soon after a large dose of Arsenic has been swallowed, an austere taste, and a sense of heat and constriction of the pharynx and œsophagus are perceived; in a short period excruciating pains in the stomach and bowels, accompanied with vomiting of the most violent character, the matter voided being generally of a brown colour, and not unfrequently mixed with blood; with these symptoms are conjoined an inexpressible anxiety about the præcordia, and frequent faintings; the stomach at the same time acquires such a high degree of irritability, as to reject the mildest fluids.

The alvine discharges now become frequent and painful, and consist of dark and extremely fœtid matter, frequently mixed with blood. The thirst is unquenchable, and the heat of the surface becomes extreme. The pulse is small, frequent, and irregular; palpitations of the heart, violent cramps in the legs, sometimes a painful strangury and bloody micturition ensue. The powers of life begin to fail, respiration becomes laborious, cold sweats break out, hiccup occurs, the countenance assumes a singular character of anxiety and distress, a livid circle appears around the eyes, the pulse is imperceptible, the body swells and sometimes becomes covered with a species of miliary eruption, or with dark purple spots. In some cases convulsions ensue, but delirium, or loss of reason, is very rarely the consequence of this species of poisoning, and the unfortunate sufferer is conscious until a few moments before the termination of his existence. Such are the general symptoms, but it is rare to see them all united in the same case; sometimes the greater part of them are absent. *M. Chaussier* reports the case of a robust middle aged man, who swallowed a quantity of arsenious acid in large lumps, and died without discovering any other symptom than slight syncope; other cases are related where only vomiting and purging (*a*) have been observed, and the symptoms have been mistaken for those of *cholera spontanea.*

The practitioner is therefore not to withhold his belief in a case of poisoning, on account of the absence of several of those symptoms which are enumerated in systematic works on Toxicology.

It is only by the study of individual cases, that he

(*a*) See the case reported by *Dr. Yelloly*, in the 5th volume of the Edinburgh Med. and Surg. Journal.

can learn to appreciate the just value of those pathognomonic combinations which afford the least exceptionable evidence upon such occasions.

The different modes of Poisoning by Arsenious Acid.

It has been proved by numerous experiments that the life of an animal may be destroyed with equal certainty by arsenious acid, whether it be *internally* administered, or *externally* applied to abraded surfaces, sores, or bleeding wounds; and it has been, moreover, shewn, that in either instance the symptoms will be analogous, except in the latter case they will often be more rapid in their course.

Lionardo di Capoa relates the case of a child killed by the violent vomiting and purging arising from a slight wound made in the head by a comb, wet with oil in which arsenic had been infused for the purpose of killing vermin; and we have numerous instances on record, where the application of arsenical cerates and ointments has been followed by violent and dangerous symptoms. We also learn from the different historians of the Plague of London, that the arsenical amulets which were worn, as preservatives, on that occasion, were sometimes attended with deleterious consequences; *Crato* (*a*) observed an ulcer of the breast produced by them. *Verzascha*, violent pains and syncope. *Diemerbroeck*, (*b*) and Dr. *Hodges*, (*c*) death itself. Amongst the foreign authors who have related cases of poisoning by the external application of arsenic we may mention *Desgranges*, (*d*) who records the history of a chambermaid, poisoned by hav-

(*a*) Epist. 168.
(*b*) De Pest. Hist. 99. Annot.
(*c*) De Peste Lond. p. 239.
(*d*) Recueil Periodique de la Societé de Med. de Paris, tom. vi. p. 22.

ing rubbed her head with an arsenical ointment for the purpose of destroying vermin; and *Roux*, (*a*) who confessed to have killed a girl of eighteen by an application of the "*Pâte Arsenicale*" to a cancerous breast. *M. Renault* has also given us the results of his experiments upon Arsenic when applied externally to dogs; when the skin was sound, it excited a pustular eruption without inflammation; but, when the skin was broken, more serious effects followed, both general and local, and in some cases death. (*b*). In an experiment performed by Mr. *Hunter*, and Mr. *Home*, in which arsenic was applied to a wound in a dog, the animal died in twenty-four hours, and the stomach was found to be considerably inflamed. Mr. *Brodie* repeated the experiment several times, always with the precaution of tying a bandage, to prevent the animal licking the wound; the results were uniform; the stomach was, in every case, not only more violently, but more rapidly, inflamed, than when the poison had been internally administered, and it even preceded any inflammatory appearance of the wound. In the *Journal de Medecine*, the following case is related of a woman who was killed by her husband having insinuated powdered arsenic into the vagina, (*c*) at the moment of enjoying the conjugal

(*a*) Nouveaux Elemens de Med. operat. par *J. P. Roux*.

(*b*) Nouvelles Experiences sur les Contre-Poisons de l'Arsenic. Par *Casimir Renault*. A. Paris. A. 9, pp. 119.

(*c*) A belief in this mode of poisoning appears to be of very ancient origin. CALPURNIUS BESTIA was said by *Pliny* (Hist. Nat Lib. 27. Cap. 2.) to have been particularly skilled in such a process, and to have murdered many of his wives when asleep, by bathing the parts of generation with the juice of Aconite; and Dr. *Gordon Smith*, in his work on Forensic Medicine, relates, on the authority of *Schenckius*, the tragical death of *Ladislas*, or *Lancelot*, surnamed the Victorious and the Liberal, who succeeded to the contested throne of Naples in 1386, and died at the age of thirth-eight in great pain, in

rites. "A woman at *Leneux, departement de l'Ourthe*, aged forty, having died after a short illness, attended with considerable tumefaction of the genital parts, uterine hemorrhage, vomiting, and purging, the body was inspected by order of the mayor, when the surgeons reported that they found the vulva in a state of gangrene, the abdomen much distended with air, and the intestines inflamed and gangrenous. The culprit was arrested, convicted, and executed." In the *Acts of the Society of Copenhagen*, a similar crime stands recorded, and which was also committed by a peasant; in this latter case, although some small pieces of arsenic were found within the vagina, yet some doubts arose respecting the possibility of such a species of poisoning, and the magistrates accordingly consulted the College of Medicine of Copenhagen, who decided the question in the affirmative, having first instituted a series of experiments upon horses.

Death may also be produced by the introduction of arsenic into the rectum; it is said that Sir *Thomas Overbury*, after the failure of the various poisons (*a*) that were administered to him, was at last despatched by an arsenical glyster.

With respect to the quantity of arsenic required for the production of such effects it is difficult to offer a decided opinion, as its operation must in every case be liable to contingency; but a very few grains are in general amply sufficient.

consequence of having been poisoned by the daughter of a physician, of whom he was passionately fond, *per concubitum*. Sir *Thomas Brown*, in his *Vulgar Errors*, alludes to an ancient story of an "Indian king that sent unto *Alexander* a fair woman, *fed with Aconites*, and other poisons, with the intent that she either by converse or *copulation* might destroy him.

(*a*) See page 137.

Physiological action of Arsenious Acid.

It had long been supposed that arsenic occasioned death by inflaming the stomach; but Mr. *Brodie* (*a*) has very satisfactorily proved, that its influence arises from its being absorbed, and that it must be regarded as a *vital* rather than as a *chemical* agent, and as having a constitutional, not a local mode of operation.

In the first place, he has in many instances found the inflammation of the stomach so slight, (*b*) that on a superficial examination it might have been easily overlooked; and in most of his experiments with arsenic, death took place in too short a period to be considered as the mere effect of inflammation. In the next place we have already shewn that in whatever manner the poison is applied, whether *externally* to a wound, or *internally*, to the alimentary canal, the same inflammatory appearance will be visible in the stomach; a fact which can only be explained by admitting that the poison is absorbed, and that it acts upon these organs through the medium of the circulation; it acts at the same time upon the brain, and heart, but with different degrees of force in different cases; so that it is sometimes difficult to ascertain which of these organs is the first to fail in its functions. According then to these experiments and observations, inflammation of the alimentary canal is not to be considered as the general cause of death in poisoning by arsenic; and yet cases will occur, where the local affection

(*a*) *Philosophical Transactions.* 1811.

(*b*) M. *Orfila* observes that there are many cases of poisoning by arsenious acid introduced into the stomach, in which we are unable to discover the slightest appearance of erosion or inflammation in the alimentary canal; such cases are recorded by *Chaussier*, *Etmuller*, *Marc*, *Sallin*, and *Renault*.

may prove fatal, the animal having survived the effects produced on the organs more immediately subservient to life, as the brain and heart. Mr. *Henry Earle* communicated to Mr. *Brodie* a case highly illustrative of this fact, which occurred in St. Bartholomew's hospital; a woman had taken arsenic, and having recovered from the alarming symptoms which first occurred, died at the end of four or five days, when upon dissection, there appeared extensive ulcerations of the stomach and bowels. This then was evidently a case of "*Consecutive*" poisoning.

The dissertation of *Dr. Jaeger*, to which we have before alluded, contains the result of a very extensive series of experiments, in illustration of the physiological action of the arsenic. He diligently examined its effects upon all classes of organized beings, as well of the vegetable as of the animal kingdoms. The general conclusions which he has drawn from his experiments on vegetables are, that arsenic is in most cases a rapidly destructive poison to them, with the exception perhaps of a few of the simplest forms of existence; (*a*) and that their death was induced by means of the gradual absorption and distribution of the poison by the vessels and cellular membrane, so that the parts died in succession, as the particles of the poison reached them. *Dr. Jaegar* also found that arsenic was a quick and destructive poison to animals, and that death was preceded, in every instance, from the infusory animalcula up to man, by inordinate motions; and that the secretion was most remarkably increased from the mucous membranes.

(*a*) We well remember performing some experiments at Cambridge, many years ago, upon mildew, which as far as they went corroborate this assertion of *Jaegar*, for its propagation was not prevented by arsenic. See also "The effects of Arsenical fumes," vol. 1, p. 332.

His experiments also proved that arsenic exerted the most powerful effects, when it was injected into the veins, or applied to a bleeding wound; next, when it was introduced into the stomach; but less so, when injected into the large intestines, which have fewer absorbing vessels. (*b*)

Organic Lesions, discovered on Dissection.

The examination of the bodies of persons poisoned by arsenic, must not be expected to furnish constant and uniform results, since they will be found to vary very considerably in different cases. As we have already considered the value of accelerated and retarded putrefaction, as an indication of poisoning, we shall at once proceed to the description of the morbid phenomena which are presented by the internal organs on dissection. The stomach and intestines are the parts in which we may expect to find the most decided marks of the ravages from arsenic. The former viscus will be found more or less inflamed; in some instances, the dusky redness will appear in patches, interspersed with points and streaks of a brighter hue; the villous coat of the stomach will be almost always softened, and, as if macerated, can be easily rubbed off in pieces with the fingers from the coats beneath; actual ulceration and sloughing are, according to the observations of *Mr. Brodie*, never found unless where death is late in taking place, in which case extensive ulceration of all the coats, amounting to actual perforation, may be expected to happen. This statement agrees with the observation of *Ruysch*, who says that where there had been sufficient time, he found the stomach ulcerated in those

(*b*) See Edinburgh Med. and Surg. Journ. for January 1, 1811.

who had died from the effects of arsenic, but that if death supervened earlier, he only discovered bloody points, distant from each other, throughout the viscus. On the subject of sloughs upon such occasions, our enlightened author remarks, that anatomists have often been betrayed into a fallacy respecting their true nature; on opening the stomach of a dog which had taken a large quantity of arsenic, *Mr. Brodie* observed a dark brown spot about an inch in diameter, having all the appearance of a slough; on a closer examination, however, it appeared that this spot was no other than a very thin layer of coagulated blood, of a dark colour, and adhering very firmly to the surface of the mucous membrane, and having a few particles of arsenic entangled in it. He states that he has at several times observed a similar appearance but occupying a less extent of surface; and he informs us that, in the Hunterian museum, there is a human stomach, which was preserved for the sake of exhibiting what was considered a slough, produced by the action of arsenic; but that, on examining the preparation carefully, the dark coloured spot was discovered to be simply a layer of coagulated blood, similar to that before described. *Dr. Baillie* and *Dr. Yelloly* have found the stomach thickened in several parts, as if by coaguable lymph, and in one case the thickening of the coats was the only alteration of structure observable; and *M. Renault* relates a case, where the arsenic was taken in large pieces, which produced no other effect than slight syncope on the approach of death; and that, upon opening the body, the arsenic was found in the state it was swallowed, but there was neither inflammation nor erosion of the stomach. Where the arsenic has been swallowed in substance, it will be generally found attached to the

membrane of the stomach by a peculiar glairy fluid; if the poison should have been administered in solution, the same organic lesions will be discovered, but the presence of the arsenic in the stomach can scarcely be expected, although the contents of the viscus, as well as all the matter ejected from the body before death, must be carefully examined by a chemical process to be hereafter described. The duodenum, like the stomach, generally affords evidence of the same inflamed and disorganized condition; and the whole track of the intestinal canal will be found more or less affected, according to the quantity of arsenic that has been administered, the period of time which has elapsed before death, and other circumstances which have been already enumerated as capable of modifying the action of this destructive substance. It however deserves notice that in many cases the rectum appears to be more affected than the other intestines; *Dr. Male* * states, that he has frequently found it abraded and ulcerated, and even more inflamed than the stomach itself; *Mr. Brodie* likewise observed, in his physiological experiments upon this substance, that the inflammation produced by it was greatest in the stomach and the rectum. *Dr. Baillie* has recorded several instances where a mortification of the rectum followed as an effect of this poison; and in the case of *Mr. Blandy*, detailed in the *Appendix*, p. 237, *Dr. Addington* stated, that the extremity of the rectum was extremely painful, and surrounded by excoriations and ulcers.

Mr. Brodie has stated, in the paper to which we have so often alluded, that the organic lesions occasioned by arsenic are confined to the stomach and n-

* Elements of Juridical Medicine, p. 76.

testines, and that he *never found any appearance of inflammation in the pharynx or œsophagus.* This statement, however, is at variance with a great weight of authority; we have ourselves witnessed cases in which dissection has demonstrated extensive inflammation in these parts; indeed it would appear, that this poison acts more particularly on the mucous membranes; and it is reasonable therefore to conclude, that those with which it comes in actual contact will not escape its virulence. The serous membranes which receive less blood, and more lymphatics, are necessarily less affected by it.

In the case of *William Mitchell*, as related at *page* 188, the patient complained of soreness of the eyes, heat and uneasiness in the mouth and throat; and the surgeon observed the membrane on the palate and uvula to be detached; so in that, again, of *Mr. Blandy*, *Dr. Addington* found on inspection that "his tongue was swelled, and his throat inflamed and excoriated; his lips, especially the upper one, dry and rough, and having angry pimples on them; the inside of his nostrils in the same condition, and his eyes a little blood shot." *(Append. l. c.).* In the celebrated Scotch case of *Oglivy* and *Nairne* (*see page* 184) *Peter Meik*, surgeon of Alyth, deposed, that, upon inspecting the body four or five days afterwards, he found "the tongue swelled beyond its natural size, and cleaving to the roof of the mouth, which he had never observed after a natural death." Many more instances might be adduced to shew that the fauces, pharynx, and œsophagus are very frequently inflamed and excoriated by the ingestion of arsenic. Mortification of the pudenda (*a*) has been

(*a*) Prestwich on Poisons.

said to be an effect peculiar to the action of arsenic; certain it is that in males, priapism is sometimes a symptom of this poison, and the penis is found swollen and red after death, as was observed in the case of *William Mitchell* (p. 190). The scrotum was also enlarged and of a dark colour. We have been long aware that persons exposed to the fumes of arsenic, or accustomed to handle any of its preparations, have been liable to a peculiar affection of these parts, but we have generally explained the fact by supposing that the poison had in such cases, been locally applied to them. The author has been lately informed by his friend *Mr. Parkes*, that several persons in his establishment were thus attacked, during the time they were engaged in preparing an arsenical solution, as a dye for the calico printers; and we have stated on another occasion, (*a*) that the smelters and workmen engaged in the copper works, and tin burning houses of Cornwall, are occasionally affected with a cancerous disease in the scrotum, somewhat similar to that which infests chimney sweepers. It is also singular that *Stahl*, in describing the putrescent tendency in the bodies of those who die from this poison, mentions in particular the gangrenous appearances of the parts of generation. The other organs of the body do not exhibit any particular appearances, which ought to be regarded as characteristic of death by arsenic; we must necessarily expect to find the traces of morbid action, especially where life has been unusually protracted; and the serous effusions found in the body of *William Mitchell*, are to be referred to such a cause.

Mr. Brodie has stated that, in animals killed by arsenic, the blood is usually found fluid in the heart

(*a*) Pharmacologia, Edit: 5. vol. ii. p. 89.

and vessels after death; this agrees with the observation of *Ruysch*, who says that he never found the blood coagulated in the human body, after death occasioned by this poison; as well as with that of *Dr. Jaeger*, who describes the cavities of the heart, especially of the right side, to be, upon these occasions, turgid with blood, but that coagula are very seldom found in them.

A question, of a very considerable importance in a forensic point of view, has arisen with respect to the means, by which we may distinguish whether arsenic, found in the body, had been introduced into the digestive canal during life, or after death. In general, this fact is placed beyond suspicion by the testimony of those to whose care the body had been confided, previous to dissection. But cases have occurred where a poisonous substance has been introduced into the rectum of a dead body, with the diabolical intention of accusing an innocent person of having been the perpetrator of the poisoning. We are not aware of any English case of this kind, but *M. Orfila* states that in the proceedings of the Criminal Court of Stockholm such a case stands recorded. Fortunately there would not be much difficulty in detecting the crime; for were the arsenic applied to the rectum after death, the change of structure would not extend beyond the part in actual contact with it, but would be distinctly separated from the rest of the intestine *by a well defined line of demarcation*, which can never happen where the arsenic has acted during life; for, in this latter case, the transition from the diseased to the healthy structure will be gradual, and the limits of each imperceptible.

Before we conclude our observations upon the organic lesions occasioned by arsenic, we may caution

the anatomist not to confound the red or violet colour which characterises inflammation, with that which has been occasionally found to arise from the ingestion of certain coloured drinks. The following case related by *Foderé*, and cited by *Orfila*, may serve to illustrate this subject. "A private person of Châlons sur-Marne, who was in a state of convalescence from a disease under which he had laboured, took a slight purgative, and died very shortly afterwards. He was believed to have been poisoned through some error in the medicine, and in order to be assured of this, the body was opened. The œsophagus and stomach were found to be red, and in certain places livid, as if in a state of gangrene. These appearances at first induced a belief that the deceased had died from poison; but *M. Varnier*, a physician of Châlons, concluded from the appearances, that death was the consequence of the disease, and that the apparent convalescence was only an insidious respite. It became therefore necessary to give some account of the state of the œsophagus and stomach; and having learnt that the deceased was in the habit of using a *strong infusion of red poppies*, the idea immediately struck him that the extraordinary colour of these organs might possibly depend on this infusion. In order to determine the validity of this explanation, he caused a dog to swallow, several times, a similar infusion; when upon opening its body, he discovered that the corresponding parts of this animal had assumed the same colour as had been observed in the stomach of the deceased abovementioned, and, moreover, that this violet red colour was so firmly fixed that it resisted the action of repeated washings." *Tincture of Cardamoms* will also be liable to occasion a coloured appearance in the

stomach, as described in *Mr. Stanley's* case of the death of a woman by a dose of opium. (*a*)

Of the Chemical Processes, by which the presence of Arsenious Acid may be detected.

This poison may either be submitted to the judicial physician for examination, in its solid form, or in that of solution; and in this latter state it may be mixed with various alimentary substances, whose presence will necessarily embarrass the inexperienced operator, and multiply the apparent difficulties of his task. It becomes our duty, therefore, upon this occasion, to enter very fully and minutely into the history of the various processes, which have been proposed for the solution of the important problem under consideration; to appreciate the relative value of each, and to point out the sources of fallacy and failure, to which they are severally exposed.

Such a review of the subject would, moreover, appear to be essentially necessary at the present period, since the evidence, lately delivered on an extraordinary trial, (*b*) has, to a certain extent, very unjustly shaken the public confidence in the tests of chemistry. We shall therefore proceed to consider the processes which are calculated to lead to the detection of *Arsenic*, in relation to the different circumstances under which it may be presented for investigation, viz. 1, In a solid form; 2, In the simple state of solution; and 3, In the state of combination with various alimentary substances.

1. *The Arsenic is in a solid form.* This is the most simple case which can occur, and the experiments by

(*a*) Medical Transactions, vol. vi, p. 414.

(*b*) See Appendix, page 277.

which its presence is to be demonstrated, will constitute the basis of the inquiry, which we shall be hereafter called upon to institute, for the detection of the same substance under other circumstances of mixture and combination.

The order of succession to be observed in the different experiments which we are about to describe, must, in a great measure, be regulated by the quantity of the material to be submitted to examination. Should it be small, it will be prudent to reserve the process of metallization, by which a considerable loss must necessarily arise, until we have submitted it to the various re-agents which are calculated to afford indications of its nature. If, on the contrary, the quantity of the substance exceed two or three grains, it will be adviseable to proceed in its examination by the following processes, reserving a portion for future analysis.

A. *By its reduction to a metallic state.* Mix a portion of the suspected substance in powder, with three times its weight of *black flux* (*a*); put the mixture into a thin glass tube, about eight inches in length, and a quarter of an inch in diameter, and which is hermetically sealed (*b*) at one end. Should any of the

(*a*) This substance may be said to consist of Charcoal, in a state of extremely minute division, and the sub-carbonate of Potass. It is prepared by deflagrating, in a crucible, two parts of Super-tartrate of Potass with one part of Nitrate of Potass.

(*b*) In order to close the end of the tube, where a blow-pipe is not to be procured, (which, says *Dr. Bostock*, we may suppose upon these occasions will often be the case) the end is to be placed in a common fire until it is completely softened, and a pair of small tongs being at the same time made red hot, the tube is to be withdrawn from the fire, and the heated end pinched by the tongs, and at the same time bent up at an acute angle, so as to be brought parallel to the body of the tube The tube is then to be heated a second time, and being again firmly pinched by the hot tongs, the end will be found to be completely impervious.

powder adhere to the sides of the tube it must be carefully brushed off with a feather, so that the inner surface of its upper part may be perfectly clean and dry. The closed end of the tube, by way of security, may be thinly coated with a mixture of pipe-clay and sand (*a*); but this operation is not absolutely necessary. The open extremity of the tube is to be loosely plugged with a piece of paper. The coated end must now be submitted to the action of heat, by placing it in a chaffing dish of red hot coals, for ten minutes, or a quarter of an hour; when, if our supposition respecting the nature of the substance has been correct, metallic arsenic will sublime, and be found lining the upper part of the tube with a brilliant metallic crust. The glass tube, when cold, may be separated from its sealed end by the action of a file, which will enable us to collect and examine the metallic sublimate. If a portion of this brilliant matter be laid on heated iron, it will indicate its nature by exhaling in dense fumes, having a powerful smell of garlic. Another portion should be reserved for future experiments.

This method of detecting the presence of *Arsenious acid* has been considered the most decisive, and indeed the only unexceptionable one, but of this we shall speak hereafter; at present we have only to observe, that it is very far from being a minute test,

(*a*) *Dr. Bostock* states that the best proportions for this coating are, one part of common pipe clay, to three parts of fine sand; which are to be well kneeded together, and reduced to such a state of tenacity, that the lute will readily adhere to the tube, and its different parts unite without forming a visible seam. "*Observations on the different methods recommended for detecting minute portions of Arsenic, by J. Bostock, M.D.*" Read before the Liverpool Medical Society, and published in the Edinburgh Med. and Surg. Journ. April, 1809.

for *Dr. Bostock* (*a*) confesses that where less than *three-fourths of a grain* were used, he could not say that the metallic crust was clearly perceptible; and *Dr. Black* (*b*) appears to have considered that *one grain* was the smallest quantity which could be distinctly recognised by such a process.

Chemists were formerly (*c*) in the habit of at once projecting any substance, supposed to be *Arsenic*, on some burning body, in order to develope the alliaceous odour; we have accidentally stumbled upon an instance of this kind, in the fourth volume of the *London Medical and Physical Journal*, which may serve as an illustration; it is a case communicated by *F. Thackeray, Esq.* of a child poisoned by arsenic, in which the author says, "*the inner surface of the stomach was very red, and was studded throughout with a white powder, which*

(*a*) See the paper above quoted.

(*b*) *Black's* Lectures, v. ii, p. 430.

(*c*) *Foderé* recommends this process, *Traité de Med. Leg.* t. iv, p. 153; and Dr. Jaeger, in his Thesis, before quoted, observes that he has been enabled to recognise the tenth of a grain of arsenious acid, although mixed with sugar, by its odour, when thrown upon burning coals! We must be allowed to question this fact; Dr. Jaeger, no doubt, believed that he recognised the alliaceous odour, but it must have been the sole effect of the imagination. Dr. Bostock states that such a test is not to be depended upon; for, unless the arsenic be in considerable quantity, the odour is not sufficiently perceptible; and if it be mixed with either an animal or a vegetable substance, the smoke and smell arising from these bodies, when heated, will altogether prevent our recognising the peculiar odour of the arsenic. When a quantity of arsenic is mixed with an equal weight of flour, and placed upon iron at a low red heat, so as not to cause the flour to inflame, the suffocating smoke that arises from the latter can be alone perceived; nor is it possible to discover that any thing has been mixed with it. *Edinb. Med. Journ. l. c.* This last objection of Dr. Bostock is true in fact, although it admits of a different explanation, for at a low temperature the arsenious acid will be volatilized *without decomposition*; in which case no alliaceous odour can be developed.

when exposed to the flame of a candle, yielded fumes, and a garlic odour was emitted, proving it was arsenic; of which there can be no doubt, as the girl afterwards confessed that she had given arsenic to the infant."

After the facts we have offered with respect to the *alliaceous odour* of arsenical fumes, it is only necessary to state, in this place, that such a test, when conducted in the manner just related, must be considered as extremely equivocal.

Another method of identifying "*White Arsenic*," by metallization, is to form at the moment of its reduction, an alloy with copper, which may be easily effected in the following manner: Mix the suspected powder with *black flux*, as in the former experiment, and place the mixture between two polished plates of copper; bind them tightly together by iron wire, and expose them to a low red heat; if the included substance contain arsenic, a silvery white stain will be left on the surface of the copper, which is an alloy of the two metals. In this, as in the former experiment, the presence of an *alkali* in the flux is essential, since it forms immediately an *arsenite of potass*, and thereby fixes the arsenious acid, and prevents it from being volatilized before the temperature is sufficiently high to enable the charcoal to decompose it; we therefore differ with *Dr. Bostock*, when he states that *powdered charcoal* may be substituted for the *black flux*.

The property of *whitening* copper is regarded as a very satisfactory test of the presence of arsenic; but *Dr. Bostock* has pointed out some circumstances attending it, which we shall here enumerate for the instruction and satisfaction of the less experienced operator. "It may be necessary," says he, "in the first

place, to describe the phenomena that take place when copper is heated according to the process that is described above, but without the addition of the arsenic. Two copper disks, of nearly an inch and a half in diameter, scoured bright with sand, had one grain of powdered charcoal, made into a paste with oil, placed between them; they were bound together with an iron wire, and then kept red hot for ten minutes. When they were withdrawn from the fire, the metal was found to have lost its former appearance, and to have acquired the dull white colour of lead or zinc; the insides of the disks were found to present the same whitish appearance, except on the spot where the charcoal was placed, a small part of which still remained unconsumed. As the disks cooled the whitish matter which covered them began to separate, and fly off with some force, in the form of small scales, leaving a clean surface of the proper copper colour. The charcoal was rubbed off, and the surface below it was found smooth and polished; it had acquired a light colour, resembling that of brass; and, near the centre, there was a small spot, which approached to a steel grey. This appearance still continued, after it had been rubbed with fine sand. The above description," concludes *Dr. Bostock*, "will probably impress the Society (*a*) with the same idea, that, I confess, it gave to myself, that if I had performed this experiment upon a substance, which had been suspected to contain arsenic, and I had not been aware of the appearance that I was to meet with, I should have conceived that I had detected its presence. Upon repeating the process, in precisely a similar manner, except that one grain of

(*a*) The paper was read before the Liverpool Medical Society.

arsenic was added to the charcoal, the oxidation of the copper took place as before, and a small part of the charcoal remained unconsumed; but upon rubbing it, the white stain was perfectly visible. However, when these disks were compared with those in which the former experiment had been made, the difference between them seemed more in *degree* than in *kind;* so that I should not choose to decide upon the presence of arsenic, as indicated by this test, unless the result were more obvious than we can ever expect to find it, where the quantity of arsenic is so small. It may be proper to observe, that copper, whitened in this manner by arsenic, is very subject to tarnish; in three days I could with difficulty distinguish which of the disks had been employed in these two experiments."

In connection with the different modes of identifying arsenic by metallization, we may relate a test lately proposed by *Mr. A. Thomson*, which, as a collateral proof, merits some attention. "Into any solution, in which arsenic may be suspected, stir a moderate quantity of charcoal powder; allow it to settle; then pour off the clear supernatant liquor, or filter the mixture; and when the powder which remains on the filter is dry, sprinkle some of it on a red hot poker; if the solution contain arsenic, the odour of garlic will be rendered sensible. This effect becomes more obvious if a few grains of dry sub-carbonate of potass be added to the dried charcoal powder. (*a*)

If, instead of *Black flux*, or charcoal, the arsenious acid be heated in a glass tube with quick-lime, a sudden ignition will take place, when one part of the

(*a*) London Dispensatory. Edit. 3, p. 176.

white arsenic will be metallized, and the other farther acidified, so as to produce an *arseniate of lime;* in this case, therefore, a certain portion of the arsenious acid is robbed of its oxygen to complete the acidification of the rest.

The habitudes of arsenious acid with the *nitrates*, as first observed by *Kunkel*, deserve also some attention. If they be heated together, the former will be oxygenated at the expense of the nitric acid, nitrous acid vapour will be disengaged, and an *arseniate of potass* remain. The forensic chemist may avail himself of these facts, and obtain a very useful test, which may be applied in the following manner. (*a*) Take a grain or two of the suspected powder, and mix it with double the quantity of *Nitrate of Potass*; introduce this mixture in a small glass tube, and apply the flame of a spirit lamp under the powder; when, if it contain arsenic, the nitrate will be decomposed, nitric oxide and nitrous acid be evolved in a gaseous form, and an arseniate of potass remain.

The acid vapour may be easily recognised by its colour and smell, or by placing a piece of moistened litmus paper within the tube. The *arseniate* may be identified by the *brick-red* precipitate, produced in its solution, by *Nitrate* of Silver. So small is the quantity of arsenic required for this latter mode of trial, that *Mr. Smithson*, in a late paper, observes "that a drop of a solution of arsenious acid in water, which at the height of 54·5 *Fah.* contains not more than 1-80th of the acid, put to nitrate of potass in a platina spoon, and fused, affords a considerable quantity of *arseniate* of silver. Hence when no solid particle

(*a*) See a letter from *Mr. Hume* on the subject, to the Editors of the Medical and Physical Journal. July, 1810.

of oxide of arsenic can be obtained, the presence of it may be established by infusing in water the matters which contain it." (*a*)

B. *By the application of certain re-agents, or tests, to its solutions.*

a. Fused Nitrate of Silver, or Lunar Caustic. For this test we are indebted to *Mr. Hume*, who first suggested its application in the Philosophial Magazine for May 1809, (vol. xxxiii). His method of using it is as follows: into a clean Florence flask introduce two or three grains of the suspected substance, in the state of powder, to which add about eight ounces of rain or distilled water, and heat the solution until it begins to boil; then while it boils frequently shake the flask, and add to the hot solution a grain or two of sub-carbonate of potass, agitating the whole to make the mixture uniform. Pour into a wine glass about two table spoonsful of the solution, and touch the surface of the fluid with a stick of lunar caustic. If arsenic be present, a beautiful yellow precipitate will instantly proceed from the point of contact, and settle towards the bottom of the glass as a flocculent and copious precipitate. By this test the 60th part of a grain may be satisfactorily recognised in two ounces of water. The presence of some alkali is essential to the success of the experiment, since arsenious acid is incapable, by the operation of simple affinity, to decompose the *nitrate of silver.* (*b*)

(*a*) On the detection of very minute quantities of Arsenic and Mercury. By *James Smithson*, Esq. F. R. S. *Annals of Philosophy*, August, 1822.

(*b*) If any trifling opacity occur in a simple solution of arsenic, when assayed by the nitrate of silver, it may be considered as the effects of

The validity of this test has been questioned on several distinct grounds, and which the author has endeavoured to answer in another work (*a*); such, however, is the importance of the question in its judicial consequences, that we shall re-consider it on the present occasion.

Objection 1. *The alkaline Phosphates are found to produce precipitates with silver, analogous in colour and appearance to the arsenite of silver.* This constituted one of the principal points in the evidence for the defence, on the trial of *Donnall* for the murder of *Mrs. Downing* (*see Appendix*, p. 299), and it must be admitted as a valid objection, if the experiment be performed in the manner just stated; but there are other reagents which will immediately distinguish these bodies, as we shall presently have occasion to state, under the history of the *Ammoniuret of silver*, as a test for arsenic. The author has also shewn that there is a mode of so modifying the application of the present test, that no error or doubt can arise in the use of it, from the presence of any phosphoric salt. This method consists in conducting the trial on writing paper, instead of in glasses; thus—drop the suspected fluid on a piece of white paper, making with it a broad line; along this line a stick of *lunar caustic* is to be slowly drawn several times succes-

some casual impurity; this may be farther demonstrated by bringing over the surface of the arsenical liquid, a piece of blotting paper, or a stopper moistened with a solution of ammonia, when there will instantly form a copious yellow precipitate of arsenite of silver. If this experiment be performed by spreading the mixed solutions of arsenious acid and nitrate of silver over a surface of glass, laid upon white paper, the result will be most striking and beautiful, for on slowly bringing the ammoniacal test over it, the yellow cloud will gradually diffuse itself over the surface.

(*a*) Pharmacologia. Edit. 5, vol. ii, p. 96.

sively, when a streak is produced of a colour resembling that known by the name of *Indian Yellow*; and this is equally produced by the presence of arsenic, and that of an alkaline phosphate, but the one from the former is rough, curdy, and flocculent, as if effected by a crayon, that from the latter is homogeneous and uniform, resembling a water-colour laid smoothly on with a brush; but a more important and distinctive peculiarity soon succeeds, for, in less than two minutes the phosphoric yellow fades into a *sad green*, and becomes gradually darker, and ultimately quite black; while, on the other hand, the arsenical yellow remains permanent, or nearly so, for some time, when it becomes brown. In performing this experiment the sun-shine should be avoided, or the transitions of colour will take place too rapidly. It would be also prudent for the inexperienced operator to perform a similar experiment on a fluid known to contain arsenic, and on another with a phosphoric salt, as a standard of comparison.

In this way the *nitrate of silver*, without the intervention of any other test, is capable of removing every ambiguity, and of furnishing a distinguishing mark between the chemical action of arsenic and that of the phosphates. *Mr. Hume* (*a*) states that he has repeated this modification of his experiment with entire satisfaction; and that, in a late unfortunate case of poisoning, he derived considerable information by its application. One of the great advantages of this test is the very small quantity that is required for examination, and which will therefore never prevent our pursuing the subject through the other channels of investigation.

Objection 2. *The muriates produce precipitates*

(*a*) London Medical and Physical Journal, January, 1818.

with silver, so copious and flocculent, as to overcome every indication which the presence of arsenic would otherwise afford.

From the general use of common salt, the chemist must be prepared to meet with a *muriate* in almost every examination after arsenic, besides which this latter substance is occasionally adulterated with the *muriate of baryta* and by *sulphate of lime*. *Dr. Marcet* proposes to obviate the difficulties which the presence of a *muriate* must occasion, by adding to the fluid to be examined dilute *nitric* acid, and then cautiously applying the *nitrate of silver* until all precipitation ceases; in this way the muriatic acid will be entirely removed, while the arsenic, if present, will be retained in solution, and may be afterwards rendered evident by the affusion of ammonia, which will instantly produce the yellow precipitate in its characteristic form. It must, however, be confessed, that this mode appears complicated, and, moreover, requires some chemical address for its accomplishment; it should be also known that the yellow precipitate thus produced is not always permanent, for it is soluble in an excess of *ammonia*. Under these circumstances, it is surely preferable to precipitate at once from the fluid under examination, all the substances which nitrate of silver can affect, and then to expose the mixed and ambiguous precipitate, so obtained, to a low heat, in a glass tube, when the arsenious acid will be separated by sublimation. In this way the presence of *muriates* and even *phosphates*, may, in certain cases, be serviceable, especially if the quantity of arsenic be very minute; for, by increasing the bulk of the precipitate, we shall decrease the difficulty of its examination.

Objection 3. *Chromate of potass produces with nitrate of silver a yellow precipitate, which, when placed*

side by side with one produced by arsenious acid, cannot be distinguished by colour or appearance from it. This fact has lately been announced by *Dr. Porter*, of the University of South Carolina (*Silliman's Journal, iii.* 355); but as the presence of *Chromate of Potass* can never be suspected in any research after arsenic, in cases of forensic interest, it is unnecessary to enter into any details respecting it.

We have stated above, that in consequence of the inability of arsenious acid to decompose *nitrate of silver* by simple elective attraction, the presence of *some* alkali becomes indispensable in the examination; and for this purpose *Dr. Marcet* suggested the superior advantages which would attend the application of *ammonia*, in all those cases where the arsenic had not been previously combined with a fixed alkali; since the former does not, when added singly, decompose nitrate of silver; a circumstance which, in using the fixed alkalies, is very liable to occasion fallacy. This led *Mr. Hume* to improve his original plan, by forming at once a compound,(*a*) which he calls the *Ammoniaco-nitrate of silver*, but which may with more propriety be designated, as an *ammoniuret* of that metal.

b. The *Ammoniuret of Silver.* This is an improvement of considerable value; for, while it obviates the necessity of ascertaining the exact proportion (*b*) of

(*a*) The following is the formula for its preparation. Dissolve ten grains of *lunar caustic*, in ten times its weight of distilled water; to this add, *guttatim*, liquid ammonia, until a precipitate is formed: continue cautiously to add the ammonia, repeatedly agitating the mixture until the precipitate is nearly redissolved. The object of allowing a small portion to remain undissolved is, to guard against an excess of ammonia. Wherever the test is used, the liquid to which it is added ought to be quite cold.

(*b*) This is very important, for an excess of ammonia redissolves the yellow precipitate, and therefore defeats the object of the test. The fixed alkalies, in excess, have not such a property.

alkali required in each experiment, it possesses the desirable property of not in the least disturbing the solution of *phosphate of soda*.

c. Sulphate of Copper. This test of arsenic is the one discovered by *Scheele*; when added to the *arsenite of potass* a beautiful green precipitate (constituting a pigment known by the name of *Scheele's green*) is produced; "so decidedly," says *Dr. Bostock*, "does this phenomenon indicate the presence of arsenic, that I thought it desirable to ascertain, as exactly as possible, what were the best proportions in which the ingredients should be employed, and in what way they should be mixed, so as to exhibit the effect in the most obvious manner. After a number of trials, in which the substances were employed in various quantities, and under different circumstances, I am disposed to recommend that the proportions of the *arsenic*, the *potass*, and the *sulphate of copper*, should be to each other as the numbers *one*, *three*, and *five*, respectively; for instance, if one grain of arsenic and three grains of potass, be dissolved in two drachms of water; and, in another equal quantity of water, five grains of sulphate be dissolved, we have two solutions, which are transparent, and nearly colourless; but upon mixing them together, the whole is converted into the most beautiful grass-green, from which a copious precipitate of the same hue slowly subsides, leaving the supernatant fluid nearly without colour. If the same materials are employed, in the same manner, but without the arsenic, a delicate *sky-blue* is formed, which is so decidedly different from the former colour as not to admit of the possibility of error." In this experiment then, as well as in that with the nitrate of silver, it is necessary that the arsenious acid should be combined with an alka-

line base; and for the same reason, in order to bring the double elective attractions into play; *Mr. Hume* has accordingly availed himself of the property of ammonia, to form an *ammoniuret of copper*, which is to be made according to the formula already given for the preparation of the silver test.

d. Ammoniuret of Copper. In using this test care must be taken that it be not too highly concentrated, for in that state it will not produce precipitation.

Notwithstanding the confidence with which *Dr. Bostock* has supported the pretensions of the *Sulphate of Copper*, as an infallible test for arsenic, its validity has been lately called in question, and it has been stated that a *decoction of onions* has the property of imparting to the copper precipitate, produced by a fixed alkali, a green colour and appearance completely analogous to that which is occasioned by the presence of arsenic. This opinion was boldly advanced, and supported, on the trial of *Donnall*, before alluded to, and of which we have given a very ample report in the *Appendix*. Since this event an opportunity occurred which enabled the author to examine this alleged fact, by a fair and appropriate series of experiments, (*a*) the result of which has

(*a*) The great impression made upon the public mind in Cornwall by the above trial, produced a disposition to regard every sudden death with more than usual jealousy. In consequence, therefore, of a report having arisen that a young woman had died after an illness of forty-eight hours, and been hastily buried at Madron, near Penzance, the magistrates of that district issued their warrant for the disinterment of the body, and requested the author's attendance at the examination. The dissection was accordingly conducted in the church, when it appeared that the immediate cause of death had been an inflammation of the intestines; the stomach was found to contain a considerable portion of liquid, which was carefully collected and examined; no solid matter could be dicovered in it, nor were any particles found to be adhering to the coats of the stomach. The fluid appeared to consist principally

satisfactorily proved that the opinion was grounded on an optical fallacy, arising from the *blue* precipitate assuming a *green* colour, in consequence of having been viewed through a yellow medium. (*a*) The

of the remains of a quantity of pennyroyal tea, which had been the last thing administered to the deceased. This was divided into several distinct portions, and placed in separate wine glasses, and submitted, in the presence of the High Sheriff, and some other gentlemen whose curiosity had been excited by the late trial of *Donnall*, to a series of experiments, amongst which the following may be particularized, as bearing upon the present question, and as affording an important elucidation of it.

A few drops of a solution of *sub-carbonate of potass* were added to the liquid, in one of the glasses, when its colour, which was originally of a light hazel, was instantly deepened into a reddish yellow; the sulphate of copper was then applied, when a precipitate fell down, which every one present simultaneously pronounced to be of a "*vivid grass green*" hue; but, on pouring off the supernatant liquid, and transferring the precipitate upon a sheet of white paper, it assumed the blue colour which is so characteristic of the *carbonate of copper*. The explanation of the phenomenon, and the fallacy to which it gave rise, became obvious; the yellow colour imparted to the liquid by the alkali, was the effect of the latter body upon the vegetable extractive matter of the infusion. The other portions were then strictly examined, but no indications of arsenic or any other metallic poison were discovered.

(*a*) This explanation applies equally to the objection lately advanced by *Dr. Porter*, of the University of South Carolina, who, in his observations on the tests of arsenic, remarks, that an appearance similar to "*Scheele's Green*," is produced by the carbonate of potass, when added to a solution of the sulphate of copper in coffee, but without arsenic, more striking than if even a weak solution of arsenic were used. *Silliman's Journal*, iii. 865.

Fodere reports a case, in which an erroneous conclusion respecting the presence of arsenic was drawn, evidently owing to the same source of fallacy. The Society of Medicine at Marseilles, in consequence of a girl having been poisoned by a quack medicine, appointed a scientific person to examine the composition of the *Nostrum*; this person, strongly prepossessed with the opinion that it contained arsenic, applied the *copper test* above described, and having obtained by means of it, a *green precipitate*, reported, without any further inquiry, that the medicine in question was an arsenical solution. *Foderé*, however, suspected the correctness of the conclusion, in consequence of the residue not yielding

phosphoric salts may also, under similar circumstances, be mistaken for arsenic; for the intense blue colour of the *phosphate of copper* will, when viewed through a yellow medium, necessarily appear green. Such instances of optical fallacy are by no means uncommon in the history of chemical reagents; thus *corrosive sublimate* has been said to possess alkaline characters, in consequence of appearing to turn the syrup of violets green, whereas this apparent change is to be solely attributed to the optical combination of the yellow hue of the sublimate with the blue colour of the violet.

Whenever therefore such a source of fallacy can be suspected, the operator would do well to repeat his experiment on white paper, in the manner we have already pointed out, when treating of the silver test; and let it be remembered that the results, when obtained in glasses, should always be examined by day light, and viewed by reflected, and not by transmitted light. *Dr. Bostock* observes, that a weak solution of the sulphate of copper, without any addition, when held between the eye and the window, frequently presents a greenish tinge. It should be also known that the usual reaction of the *ammoniuret of copper*, upon a diluted solution of arsenic, is prevented by the presence of *tannin*; strong tea may therefore render the test inefficient.

e. Sulphuretted hydrogen. This is a very delicate test for arsenic, producing with its solution a beautiful golden coloured liquor, which, after a short time, lets fall a precipitate, and which will take place sooner if a small quantity of acetic acid be added. By this

by combustion, any alliaceous odour; a new analysis was therefore made, which proved the nostrum to be nothing more than a very strong alcoholic tincture of colocynth. *Médecine Légale, tom. iv. p.* 137.

re-agent so small a quantity as $\frac{1}{100000}$ may be detected in solution. The test, however, is not, says *Dr. Bostock*, sufficiently discriminative to be depended upon alone; since *tartarized antimony* and some other bodies, will produce phenomena that may be mistaken for the effects of arsenic. It has, however, the merit of not being affected by *tannin*, and may therefore be conveniently employed for precipitating arsenious acid, when dissolved in tea.

f. Lime water produces with the solution of arsenic a beautiful white precipitate of *arsenite of lime*, which easily dissolves in an excess of arsenious acid.

The precipitates occasioned by the foregoing re-agents, should be carefully collected, and treated with *black flux*, in a glass tube, for the purpose of obtaining the metallic sublimate, as above described.

We cannot quit this part of our subject without directing the reader's attention to the chemical evidence given by *Dr. Addington*, on the trial of *Mary Blandy (see Appendix, p. 241)* to prove that arsenic was contained in a powder with which she was supposed to have poisoned her father. To those in the least acquainted with the habitudes of arsenious acid, it must be evident, that no one of the appearances described by *Dr. Addington* indicates the presence of arsenic; (*a*) and his evidence is only to be reconciled upon the supposition that, instead of the arsenic itself, he, in this case, detected the foreign substances with which it had been adulterated; thus it has been before stated that *white arsenic*, as sold by the druggists, is often adulterated with *sulphate of lime;* and the decomposition of this substance by the *sub-carbonate*

(*a*) It is hardly necessary to observe that neither the carbonate of ammonia or of potass, or sulphuric or muriatic acid, produce any effect whatever in a pure solution of white arsenic.

of ammonia (*"Spirit of sal-ammoniac"*) or by the *sub-carbonate of potass* (*"Lixivium of tartar"*) would occasion the precipitation of a white substance, as stated in the evidence; it is however difficult to account for the "considerable precipitation of a lightish coloured substance" by muriatic acid *(spirit of salt)* by the presence of any impurity likely to be contained in the arsenic, or in the water employed for its solution. If any lime were present, it would probably give "white glittering crystals" of sulphate of lime, by the addition of sulphuric acid *(spirits of vitriol)*. The only plausible evidence of the presence of arsenic in the suspected powder is "the alliaceous smell and white flowers" which *Dr. Addington* describes as occurring when it was thrown on red hot iron; it must however be confessed, that from the fallacy of the other experiments, it is even impossible to place any confidence in those last mentioned.

Arsenic does not blacken a knife by which it is cut, as stated on the trial of *Eliza Fenning*; nor does it, when mixed with dough, prevent its rising. (*a*)

We have now concluded our history of the different tests which have been proposed for the detection of arsenic. Much has been said and written upon the relative degree of confidence to which they are respectively entitled, and it has been asserted on several occasions, that nothing short of the reproduction of the metal ought to be received by the tribunals of justice, as an unequivocal proof of the presence of arsenious acid. (See *Dr. Neale's Evidence on the trial of Donnall. Appendix*, p. 297.) In tak-

(*a*) Corrosive sublimate, however, produces both these effects, from causes which we have fully explained under the consideration of that poison.

ing an impartial review of all the evidence which the investigation of this subject can furnish, it must appear to the most fastidious, that the *Silver* and *Copper* tests, above described, are capable, under proper management and precaution, of furnishing striking and infallible indications; and that in most cases they will be equally conclusive, and in some even more satisfactory in their results, than the metallic reproduction upon which so much stress has been laid; and for this obvious reason, that unless the quantity of metal be considerable, its metallic splendour and appearance is often very ambiguous and questionable. The author is personally acquainted with a case, where the medical person, by no means deficient in chemical address, actually ascribed the presence of arsenic to that which was no other than a film of finely divided charcoal: in this state of doubt the last resource was to ascertain whether it yielded, or not, upon being volatilized, an alliaceous odour. Surely an unprejudiced judge would prefer the evidence of *sight*, as furnished by the tests, to that of *smell*, as afforded in the experiment to which we allude; especially after the various fallacies, which we have shewn in the course of the present enquiry, to have occurred with regard to this latter sense. But the question at issue may be easily disposed of to the satisfaction of all parties; for let it be remembered, that the application of chemical reagents on solutions suspected to contain arsenic, so far from throwing any obstacle in the way of the *metallic reproduction* of that substance, are the very steps which should be adopted as preparatory to the "*experimentum crucis.*" It is only necessary to collect the precipitates, and to decompose them in the manner already described; and this confirmation of our

results should never be neglected, for it is the bounden duty of the forensic chemist, who is called upon to decide so important a question as the presence of a corrosive poison, to prosecute by the fullest enquiry every point which admits of the least doubt; he should also remember that in a criminal case, where the life of a human being depends upon his testimony, he has not only to satisfy his own conscience, but that he is bound, as far as he is able, to convince the public mind of the accuracy and truth of his researches.

2. *The Arsenious Acid is mixed with various alimentary and other substances.*

The detection of the presence of arsenic, amidst a complicated mass of alimentary matter, has long been a problem of interest and difficulty. In the directions which have been already offered for the discovery of arsenic in solution, we have in some measure anticipated several of the resources, of which we are now to avail ourselves. It has been seen how greatly coloured fluids are capable of obscuring, and changing, and even altogether preventing, the arsenical indications. *M. Orfila*, with an assiduity and accuracy which so eminently characterise all his toxicological labours, has accordingly investigated the peculiar appearances assumed by the arsenical precipitates in different media, such as bile, tea, coffee, wine, broth, jelly, &c. Since the publication of the great work (*a*) in which these phenomena are recorded, its author has proposed a new method (*b*) of removing its

(*a*) *Toxicologie Générale*, supra citat.

(*b*) See *Leçons de Médecine Légale*, a Paris, 1821. "Experiences chimiques propres à decouvrir les poisons minéraux qui ont été mêlés avec du thé, du café, du vin, etc." *Trente-unième Leçon. p.* 415.

difficulties and embarassments, occasioned by the colouring matter of the above media; which consists in a previous application of *Chlorine*, so as to change the colour to a shade, that will not offer any optical impediment to the characteristic indications of the tests in question. We are ready to admit that such a mode of proceeding may, on certain occasions, assist the accomplished chemist in his analysis; but in the hands of a person less accustomed to chemical manipulation, we hesitate not to declare that it is subject to fatal fallacies; whereas, by collecting the precipitate, and submitting it to the process of sublimation we shall at once obtain the arsenious acid in a pure form, and be enabled to test it, in distilled water without the chance of error. Why then should we attempt to pursue our game through the windings of a labyrinth, when a direct road lies before us by which we may drive it into the open plain?

We accordingly recommend the juridical chemist, who suspects the presence of arsenious acid in broth, coffee, or any coloured liquid, to add a solution of *ammoniuret of silver*, and thus to precipitate indiscriminately all the bodies which it may be capable of so affecting. The precipitate may then be collected, and submitted to heat in a glass tube, as before directed.

But the *Arsenious acid* may perchance be so mixed with various foreign matter as to render its separation by filtration difficult; in such a case, after having boiled it in distilled water, in order to procure all the soluble matter from it, the residual mass may be evaporated to dryness, care being taken that the heat applied for such a purpose never exceeds 250° *Fah.* or we shall lose the arsenic, should any be present, by volatilization. The residue thus obtained may then be

submitted to a higher temperature in a subliming vessel, in order to procure the arsenious acid in its pure state. This process applies particularly to the examination of the matter vomited, or the feculent evacuations passed, by the patient. Should the arsenious acid have, in the first instance, been dissolved in oil, *Dr. Ure* proposes to boil the solution in distilled water, and to separate the oil afterwards by the capillary action of wick threads. If the arsenious acid be mixed with resinous bodies, *Oil of Turpentine* may be employed as their solvent, which will leave the arsenic untouched. *Dr. Black* directed the application of alcohol for this purpose, but this is obviously improper, since arsenious acid is soluble in that fluid.

If the physician be called upon to investigate the contents of the alimentary canal after death, and the arsenious acid cannot be discovered amongst the suspected matter, the stomach itself must be cut into small pieces, and in compliance with the directions of *Orfila*, boiled in ten or twelve times their weight of distilled water, which should be renewed as fast as a portion of it flies off in vapour; this liquor should be cooled and decanted, in order to put a few drops of it into the solutions of the different re-agents which we have before described. If the precipitates should indicate the presence of arsenic, we may proceed according to the directions we have already laid down; if, on the other hand, the fluid offers no indication of poison, the mass exhausted by water should be treated, according to the process suggested by *Rose*, by boiling it for some time in a solution of potass, by which means the stomach will be partly decomposed and dissolved, and the arsenious acid, with which it might have been combined, saturated by the alkali. In this state the liquor is to be filtered, again boiled,

and nitric acid added, little by little, until it passes from a dark to a clear yellow colour. The object of the acid in this stage of the process being to decompose and destroy the animal matter. The excess of acid should be saturated with potass, when an *Arsenite of Potass* will be formed, if there really existed any arsenious acid in the stomach. This *M. Orfila* recommends us to precipitate by the *Hydro-sulphuret of Ammonia*, and a few drops of nitric acid; (*Rose* prefers *lime water* for the same purpose); a yellow *sulphuret of Arsenic* will be the result, from which the whole of the metal may be obtained, by drying it upon a filter, mixing it with an equal bulk of potass, and melting it in a small glass tube.

This complicated mode of proceeding will rarely be found necessary; but it should not be neglected, where the presence of arsenic cannot be otherwise detected in the alimentary canal of those who are suspected to have died from its ingestion, especially in the examination of a body where, from the length of time it may have been under ground, there is reason to suppose that the acid exists in a state of intimate combination with the animal matter. And we may take this opportunity to observe, that advanced putrefaction, however disagreeable it may render such researches, will not, in the case of arsenic, defeat their success; let the forensic physician, then, remember, that the length of time which may have elapsed since the death of the body, ought never to be urged as a plea for not having proceeded in its dissection. The task may be personally disagreeable, but it will be less painful than the reflections which must attend a breach of duty; upon such an occasion we would address the anatomist in the quaint but ex-

pressive words of *Teichmeyer* (*a*), "*Præstat enim manus quam conscientiam cruentare et contaminare.*"

Arsenic Acid, and its Salts.

It has been stated, that the Metal Arsenic is susceptible of two degrees of oxidizement, the result of its first degree being Arseni*ous* acid, and that of its second Arseni*c* acid. This latter compound, of which we are now to treat, may be obtained by the repeated distillation of white arsenic with nitric acid. In a solid state it is white, not crystallizable; of a sour, and at the same time, metallic taste; its specific gravity is 3·391; when exposed to the action of heat in a close vessel, it does not become volatile, but melts and vitrifies; thrown on burning coals, it swells, parts with its water, and becomes opaque; if the process of deoxidation be continued, it will, at length, rise in vapours, like those of arsenious acid, and which, like them, will yield an alliaceous odour, or not, according to the circumstances already explained. The *Arsenic acid* dissolves very readily in water, and is even indeed deliquescent. With alkalies, earths, and oxides, it constitutes a class of salts, called "*Arseniates*," all of which, as well as the pure acid, are extremely active poisons; fortunately, however, they are not much employed (*b*) in this country, and are not likely to become the instruments of crime. These salts, like those of the arsenious acid, are obedient to the different re-agents

(*a*) Chirurg. Med. p. 185.

(*b*) The *arsenite of potass*, which has been long known under the name of the "*arsenical salt of Macquer*" has been used in medicine, and the Dublin Pharmacopœia contains a process for the preparation of "*arsenias kali.*"

which were enumerated under the consideration of this latter substance, but with different results; thus the *silver* test, instead of producing the yellow indication, occasions an equally characteristic precipitate of a red, or brick colour. The ammoniuret, and acetate of copper, furnish a bluish-white precipitate. The arsenic acid, in a solid form, or the arseniate, mixed with black flux, will, like white arsenic, furnish a metallic sublimate, when heated in a glass tube.

The Sulphurets of Arsenic.

There are two Sulphurets of Arsenic: the yellow variety known in commerce under the name of *Orpiment*, and the red sulphuret, termed *Realgar*. The bodies, as they occur *native*, do not appear to be endowed with the virulent powers which distinguish the other compounds of arsenic. *M. Renault* (*a*) gave as much as two drachms of the native orpiment to dogs of different sizes, from which they experienced no inconvenience. *Hoffman* (*b*) also offers his testimony of the inertness of this substance. The same observations apply to the *Realgar*. It is not a little singular that while these native sulphurets of arsenic should be so harmless, those which are produced by artificial fusions, are extremely virulent in very small doses. *M. Renault* supposed that this remarkable difference of effect was owing to the arsenic being oxidized in the latter compound, and in its metallic state in the former. This explanation, however, is not considered as satisfactory by *M. Orfila*, who states that it does not embrace all the varieties

(*a*) Nouvelles Experiences, &c, op. sup. cit.
(*b*) Opera Omnia de Venenis, 1761.

of the case, for that the *sulphuret*, which is artificially obtained by pouring the arsenious acid into a solution of sulphuretted hydrogen, is as inert as the native compounds; besides which, chemical analysis has proved that there is no oxygen in any of these *sulphurets*, and that they only differ from one another, by a greater or less proportion of their two ingredients. This apparent anomaly induced *M. Orfila* to institute a series of experiments for its investigation, but the results which he has obtained are too unsatisfactory to enable him to decide the question.

The presence of an *Arsenical Sulphuret* is to be sought for by calcination with caustic potass, in a small glass tube. The sulphuret is decomposed in a few seconds, yielding its sulphur to the potass, while its metallic element is volatilized with the usual phenomena.

Mercury.

Mercury, or Quicksilver (*a*), was known in the earliest ages. Its external characters are too familiar to require any particular description in this place. Its specific gravity is 13·568. (*b*) In its metallic state it exerts no action on the living system, except that which may depend upon its mechanical properties, although a different opinion has been entertained, (see *Pharmacologia*, art. Hydrargyrum.)

Several of the combinations of this metal are, however, highly destructive in small doses, and are consequently objects of forensic interest.

(*a*) Υδραργυρος of the Greeks from its fluidity and colour. Quicksilver. *Quick*, in the old Saxon tongue signified living: an epithet derived from its mobility.

(*b*) *Cavendish.*

Corrosive Sublimate.

Oxy-muriate of Mercury. Bi-chloride of Mercury.

This metallic salt is by far the most active of all the mercurial preparations. According to the latest views of Chemistry it is a compound of two proportionals of chlorine, and one proportional of metallic mercury, and is therefore a *bi-chloride of Mercury.* It generally occurs in the form of a crystalline mass, made up of very small prismatic crystals, which undergo a slight alteration by exposure to air, becoming opaque and pulverulent. Its taste is extremely acrid, with a metallic astringency, occasioning a sensation of obstruction in the throat which continues for some time. Its specific gravity is 5·1398 (*a*). When pulverised and thrown upon burning coals, it is immediately volatilized, giving out a thick white smoke, of a very pungent smell, not at all resembling garlic, but which irritates the mucous membranes extremely, and is highly dangerous to those who breathe it. It is soluble in eleven parts of cold, and in three of boiling water; and this solubility may be farther increased by the addition of a few drops of rectified spirit, or of muriatic acid. When swallowed in small quantities it acts as a most virulent poison. (*b*)

Symptoms of Poisoning by Corrosive Sublimate.

The effects, as well as the *modus operandi*, of this salt, will vary with the quantity swallowed. We shall, therefore, first consider the acute symptoms which supervene a dose sufficiently powerful to destroy life in a few hours; and afterwards those which

(*a*) *Hassenfratz* Ann. de Chim. xxviii, 12.

(*b*) Hence it was called by the alchymists the *Dragon.*

may arise from its long continued use in small quantities, and at different intervals.

1. *Symptoms which follow a large dose.* A most painful burning and sense of constriction is experienced in the fauces; dryness of the mouth and lips; excruciating pain in the stomach and bowels, increased by the slightest pressure, and generally attended with considerable distention; excessive vomiting and purging of frothy mucus; the countenance is frequently red and swollen, and the eyes exhibit a sparkling appearance, accompanied by contraction of the pupils. The pulse is in general quick, small, and hard; suppression of urine takes place, and cold sweats; anxiety; universal pains; convulsions, and death. If the patient survives long enough, a violent ptyalism, and sloughing of the mouth and gums may take place.

2. *Symptoms which are produced by the repetition of small doses.* In this case the mercurial salt acts as an "Accumulative Poison." (*See page* 148). The most striking of the symptoms are those arising from its specific action upon the salivary glands, in consequence of which an increased flow of saliva takes place, the gums become tender and sore, the breath intolerably offensive, and if the use of the salt be not discontinued, the teeth loosen, and even fall out, and their loss is sometimes followed by that of the bones of the palate, or maxillæ; at the same time other evils, although perhaps less apparent, soon arise; the strength and muscular powers of the body begin to fail; emaciation proceeds rapidly; cardialgia, dyspepsia, diarrhæa, and a train of morbid symptoms succeed; violent pains are experienced in the muscles, tendons, or joints; tremors of the limbs, and even paralysis may result; and in some cases, pul-

monary consumption terminates the existence of the unhappy sufferer. It has been asserted that *Corrosive Sublimate*, when taken for a long time in small quantities, will sometimes occasion all the symptoms of debility above enumerated, together with hectic fever, without producing salivation. This is a truth which the author's personal experience will enable him to confirm. The Countess of Soissons, mother of the celebrated Prince Eugene, was accused, at the latter end of the seventeenth century, of having destroyed her husband by these means. A question of considerable importance has arisen, with regard to the specific effects of mercury, which demands some notice in this place. *Whether salivation, after having entirely subsided, can ever return without a fresh exhibition of Mercury?* Two instances are related by *Dr. Mead* of the return of salivation, after an interval of several months, when not a particle of mercury had been administered, in any form, during that period. (*a*) *Dr. Male*, in his work on Juridical Medicine, (*b*) relates an analogous case which occurred in his own practice: "In March, 1815," says he, "I gave a small quantity of triturated mercury to a respectable woman in this town, who had been long ill; she became suddenly and unexpectedly salivated. She soon recovered, and enjoyed better health than she had done for a considerable time. In October, without (as she informed me) having taken any medicine whatever, the salivation returned with extreme violence, her mouth sloughed and mortified; and in a few weeks she died." *Dr. Hamilton*, the Professor of Midwifery in Edinburgh, relates in his lectures the case of a married lady, who had been

(*a*) *Mead* on Poisons, edit. 4, p. 196.
(*b*) Second edition, p. 89.

under the necessity of going through a course of mercury, under the care of the late *Mr. Bennet*, who, from motives of delicacy did not enquire very minutely into the particular circumstances; but, according to the rule of the day, gave his patient a sore mouth. Four months afterwards she miscarried, and salivation again came on. It was removed for a week, at the end of which it returned, and harrassed her for about twelve months. (*a*) The author, in his *Pharmacologia*, (*b*) has cited a case from *Hufeland's Journal*, (vol. ix) wherein mercurial influence, after its complete subsidence, had been renewed by doses of opium. In the trial of *Miss Butterfield*, at the Croydon assizes, for poisoning *Mr. Scawen*, in the year 1775, the merit of the case entirely hinged upon this question. See vol. 1, p. 301.

Physiological action of Corrosive Sublimate.

When this salt is introduced into the stomach in a large dose, it immediately exerts a corrosive action on that organ, in consequence of which the heart and brain become sympathetically affected, and death results from the suspension of their functions. For this view of the *modus operandi* of this mercurial salt we are indebted to *Mr. Brodie*, (*c*) whence it would appear that its physiological action is very different from that of arsenious acid; the former acting as a simple *escharotic*, on the coats of the alimentary ca-

(*a*) For the report of the above satisfactory case we are indebted to *Dr. Gordon Smith*, who has related it in his work on Forensic Medicine, p. 114.

(*b*) Edit. 5, vol. 1, p. 260.

(*c*) "Further experiments and observations on the action of Poisons on the animal system." Phil. Trans. 1812.

nal, the latter requiring to be absorbed, before it can display its energies. These observations, however, apply only to those cases in which the quantity of poison has been so considerable as to destroy life in a few hours; where the dose has been small, and the symptoms have arisen from its frequent repetition, the salt produces its effects by a different mode of operation. In this latter case it is absorbed, and carried into the current of the blood, so as to be distributed to every part of the living system; and it has been asserted that, after the long continued and improper use of mercury, it has been discovered in different parts of the body, and even in the brain, in the form of globules. In this way then deleterious effects may arise from the external application of corrosive sublimate, and numerous instances are recorded where such consequences have followed the injudicious use of lotions and plasters, into which it had entered as an ingredient. (*a*) In the *Medical Repository*, for December, 1821, *Mr. Sutleffe* has communicated the case of a girl of five years of age, who became salivated, and died, in consequence of an application made to the head for *tinea capitis*, consisting of pomatum rubbed up with a few grains of *corrosive sublimate.*

Antidotes to Corrosive Sublimate.

After the view which we have taken of the operation of this salt in large doses, it necessarily follows that copious dilution is the very first object which we have to accomplish, and then the ejection of the fluid by vomiting. *Sydenham* relates an interesting case of poisoning by this substance, which was successfully treated by copious draughts of water, and repeated

(*a*) For a history of the different quack medicines which contain mercury, see Pharmacologia, vol. ii, p. 239.

vomiting. (*a*) But it becomes a question of great practical importance to enquire, whether there may not exist some counterpoison or antidote which, by decomposing the salt, will at once disarm it of its virulence? This question has been investigated in a very masterly style by *Orfila*, who has clearly proved by experiment, that neither the *alkaline salts* and *earths*, *the sulphurets of potass and of lime*, nor the *martial alkaline tinctures*, as proposed by *Navier*, (*b*) deserve the least confidence; for although the salt may by some of these bodies be decomposed, yet the resulting oxide will prove as virulent as the original compound; equally inefficient are the other substances which have been proposed as counter-poisons, such as *sulphuretted hydrogen*, *solutions of sugar*, (*c*) *the infusions of Peruvian bark*, (*d*) and *metallic mercury*. (*e*)

M. Orfila having observed the facility with which *albumen* decomposes corrosive sublimate, and gives rise to a triple compound of albumen, muriatic acid, and protoxide of mercury, induced him to ascertain by experiments whether the *white of eggs* might not

(*a*) Opera Medica. Epist. i, p. 200.

(*b*) Contre-poisons de l' Arsenic, du sublimé corrosif, &c.

(*c*) Proposed by *M. Duval*, "Dissertation sur la Toxicologie."

(*d*) *M. Chausarel.* "Observations sur diverses substances Vénéneuses," p. 47.

(*e*) We find in an ancient epigram of Ausonius, that a woman gave to her husband some metallic mercury, with the design of increasing the energy of a certain poison, which she administered to him. But instead of producing this effect, the mercury, on the contrary, entirely re-established the health of the person poisoned. The celebrated *Goethe* upon asking the Professor *Doebereiner* of Jena, his opinion upon the above case, received in reply, that the poison must have been corrosive sublimate, since, of all the known poisons, it was the only one whose power was weakened by mercury.

This story induced *Orfila* to ascertain the truth by experiment, and he has shewn THAT METALLIC MERCURY IS NOT AN ANTIDOTE TO CORROSIVE SUBLIMATE.

prove an antidote to that poison; the result of his inquiry has shewn that this is the case; and that by mixing such albuminous matter, in *large quantities*, with the diluents given to provoke vomiting, the happiest effects may be anticipated. Many examples are recorded of the success of this practice. In the Transactions of the King and Queen's College of Physicians in Ireland, an interesting case of this kind is related by *Dr. Lendrick;* it is, however, but justice to state, that there are instances also of the failure of this antidote. In the 41st volume of the *London Medical and Physical Journal*, p. 204, the reader will find the case of a girl who was poisoned by a drachm of sublimate, and who, notwithstanding the copious administration of albumen, died in ninety hours afterwards.

It has lately been discovered that vegetable *gluten*, as existing in wheat flour, is capable of producing upon corrosive sublimate the same chemical decomposition, as that which we have stated to arise from the action of albumen; whence the administration of wheat flour and water has been suggested as a ready antidote. On the trial of *Michael Whiting*, for administering poison *(corrosive sublimate)* to his brothers-in-law, *George* and *Joseph Langman*, the housekeeper, *Catharine Carter*, stated in evidence, that the flour, (which was subsequently proved to contain corrosive sublimate) could scarcely be made into dumplings with milk (*a*); and another witness, *Mrs.*

(*a*) *Mr. Hart.* "What did you do with the flour and pork?

C. Carter. I made it into four dumplings, two with pork, and two without, and tied the two largest, with pork in them, up in bags.

——— With what did you mix the flour?

——— With milk.

——— When you were making these dumplings, did you observe any thing?

Hopkins, a neighbour who took charge of the dumpling that had not been boiled, described it as "*a comical sort of paste; like glazier's putty more than paste, though not greasy.*" In order to ascertain the correctness of this statement, we mixed powdered sublimate with wheat flour, and proceeded to make it into dough with milk; when the same difficulty as that stated by the above witnesses, embarrassed the process, and satisfied us of the truth of their testimony. The phenomenon would appear to depend upon the mutual chemical changes which arise in the gluten and mercurial salt.

Organic Lesions discovered on Dissection.

The œsophagus and stomach will be found inflamed, and sometimes eroded, as in poisoning by arsenic. *Salin* has asserted, that this salt never produces perforation of the intestinal tube; this, however, is not the fact; and we know not of any exclusive appearances, by which the organic lesions inflicted by this poison can be distinguished, unless indeed it be the black appearance of the stomach, as if it had been burnt, which occasionally presents itself.

——— They made different to any thing which I had ever made before.

——— Explain that difference?

——— They broke and crumbled all into little bits. I had to knock them in a stant like when we make butter. They would not hold together.

——— Had you more or less difficulty than usual?

——— More trouble than I ever had before."

Extract from the trial.

Of the Chemical Processes by which the presence of Corrosive Sublimate may be detected.

As the chemist, devoted to forensic enquiry, will be required to identify this substance under very different states of mixture and combination, we shall proceed to enumerate the various obstacles that may possibly oppose his researches; and, at the same time, to suggest the expedients by which they may be successfully evaded. Unlike arsenious acid, corrosive sublimate is so readily decomposed by various alimentary substances, that, when we attempt to demonstrate its presence in such mixtures, we shall be more frequently compelled to rest our proof upon the products of the analysis, than upon the actual reproduction of the salt.

We shall proceed to consider the best modes of establishing the presence of this salt, in the different forms in which it may occur, viz. 1, *In the solid form;* 2, *Dissolved in water or spirit;* 3, *In various coloured liquids;* 4, *In a state of mixture with various solids;* 5, *Combined with solid or liquid aliments, by which it undergoes decomposition;* 6, *In a state of combination with the textures of the alimentary canal.*

1. *The sublimate is in its solid form.* The external characters by which this salt is distinguished will go far to establish its identity; but the fact should always receive the support of a chemical proof; and as this is to be derived from the phenomena afforded by its solutions through the intervention of various tests, it will meet with full consideration in the following section, viz.

2. *The salt is in the state of solution, in water, or spirit.* Let us then suppose that we have a solution of some body in distilled water, which we suspect to

be corrosive sublimate, by what means are we able to identify it?

(*a*) *By its metallization, through the agency of galvanism.* We are indebted to *Mr. Sylvester* for first suggesting the mode by which galvanic electricity might be applied for the detection of minute quantities of corrosive sublimate in solution. His method is as follows. A piece of zinc or iron wire, about three inches in length, is to be twice bent at right angles, so as to resemble the greek letter π, the two legs of this figure should be distant about the diameter of a common wedding ring from each other, and the two ends of the bent wire must afterwards be tied to a ring of this description. Let a plate of glass, not less than three inches square, be laid as nearly horizontal as possible, and on one side drop some sulphuric acid, diluted with about six times its weight of water, till it spreads to the size of a halfpenny. At a little distance from this, towards the other side, next drop some of the solution supposed to contain corrosive sublimate, till the edges of the two liquids become joined; and let the wire and ring, prepared as above, be laid in such a way, that the wire may touch the acid, while the gold ring is in contact with the suspected liquid. If the minutest quantity of corrosive sublimate be present, the ring, in a few minutes, will be covered with metallic mercury on the part which touched the fluid.

The above experiment may be beautifully simplified in the following manner (*a*). Drop a small quan-

(*a*) We have been informed that, by this simple and beautiful test, Mr. Archdeacon *Wollaston* identified the presence of corrosive sublimate in the dumplings by which *Michael Whiting* attempted to poison his brothers-in-law, at Ely, as stated in the preceding page, as well as at 197. Although in the report of the trial in our possession, the professor does not appear to have furnished the court with any account of the process by which he discovered the poison.

tity of a solution, supposed to contain the salt in question, on a piece of gold, and bring into contact a key, or some piece of iron, so as to form a galvanic circuit; when, if sublimate be present, the gold will immediately be whitened.

A solution of *nitrate of silver* will, under similar treatment, occasion on gold a white precipitate; but as no amalgamation takes place, it is readily wiped off, and cannot therefore occasion any fallacy.

(*b*) *By precipitating metallic mercury from its solution, by the contact of a single metal.* It should be generally known that, by virtue of superior affinity, certain metals will decompose the solution of corrosive sublimate, with different phenomena; in those cases where the precipitating metal is capable of forming a direct union with mercury, we shall find the precipitates to consist of an amalgam of the metal employed; where no such combination takes place, the mercury may be frequently seen standing on the surface as a metallic dew. This is particularly striking when iron or steel has been employed. In the evidence given on the trial of *Mary Bateman* (*a*),

(*a*) Trial of Mary *Bateman* for the wilful murder of *Rebecca Perigo*, at the York Assizes, 1809. As we have on several occasions alluded to this trial, it may perhaps be satisfactory to give a short sketch of the case in this place.

This diabolical woman, under the pretext of possessing the art of witchcraft, committed numerous frauds, and worked with so much success upon the credulity of her victims, as to obtain considerable sums of money, and reduce them to the extremes of poverty; while, in order to conceal the frauds, she consigned whole families to the grave by her poisons. Her detection was brought about by the robbery of a family of the name of *Perigo*, from whom she obtained the sum of seventy pounds, besides cloathes and furniture, under the pretence of engaging a Miss *Blythe* to relieve *Perigo's* wife from the effects of an "evil wish," under which she was supposed to labour; when the appointed time arrived for the restoration of the property, and the promised cure of the wife, *Mary*

better known by the name of the "Yorkshire Witch," *Mr. Thomas Chorley*, surgeon at Leeds, stated that he had received from his assistant, *Mr. Hammerton*, a jar which he had carefully preserved in his possession, and of the contents of which he gave the following account. "Upon tasting a portion, it was very acrid, styptic, and permanent upon the tongue; I then took a small quantity of it upon a clean knife, and rubbed it with my finger; a change of colour immediately appeared; *further rubbing produced numerous globules of quicksilver*, and the knife was, at the same time, blackened by it; this change of colour led me to suspect that it must be a mercurial composition, and having made a solution of it, and subjected it to a series of tests and experiments, it is my opinion, that the mixture in the pot did contain *honey*, and *corrosive sublimate of mercury*. In order, however, more fully to satisfy myself upon this point, a mixture was made of these ingredients, when it was found to yield the same results." In the above experiment, the steel knife decomposed the sublimate, forming a *chloride of iron*, while the mercury, thus disengaged in its metallic form, being unable to amalgamate with the iron, appeared in globules (*a*) upon

Bateman sent a powder *(Arsenic)* which she directed them to add to their pudding, and advised them, should they be ill after eating it, to take a spoonful of prepared honey with which she supplied them. The wife ate the pudding, and soon afterwards died; the husband, however, very narrowly escaped: for this murder she was tried and convicted; and thus was a system of robbery and murder, scarcely equalled in the annals of crime, happily exposed and ended.

(*a*) In the Philosophical Magazine for December, 1821, a communication is to be found from a Mr. *Murray*, which would have been too ridiculous to require notice, had it not involved a question connected with the habitudes of corrosive sublimate and iron, which might possibly occasion error. After stating that certain metallic solutions may be decomposed through the agency of magnetism, he says, a solution of

its surface. At the same time the knife *became blackened*, owing to the precipitation of carbonaceous matter from the steel.

(*c*) *Carbonate of Potass.* A saturated solution of this salt, added to that of corrosive sublimate, will produce a *deep brick coloured* sediment, which is stated to consist of per-carbonate of mercury (*a*); while a muriate of potass will be found to remain in solution. The *sub-carbonate of potass* will occasion a somewhat different precipitate, of a *clear brick* colour, and consisting of a mixture of the carbonate, and oxide of the metal. (*b*)

(*d*) *Ammonia.* A solution of the volatile alkali produces a *white precipitate*, which is an insoluble triple salt, composed of muriatic acid, ammonia, and oxide of mercury; being heated it grows yellow; it passes afterwards to red, and according to *Orfila* gives out ammoniacal gas, nitrogen, calomel, and metallic mercury. In this operation the oxide of mercury is supposed to be deoxidized by the hydrogen which results from a portion of the decomposed ammonia.

(*e*) *Lime water.* This reagent may be said to decompose corrosive sublimate more perfectly than any alkaline body; occasioning a precipitate of a deep yellow colour, which will be found to be a peroxide of mercury; unless indeed the quantity of lime water be very small, when it will be a sub-muriate of the peroxide.

corrosive sublimate may be thus made to yield metallic mercury, by introducing into it a bar of magnetised iron! He had not the wit to inquire whether unmagnetised iron might not prove equally powerful as a decomposing agent.

(*a*) (*b*) *Orfila*, l. c.

(*f*) *Nitrate of Tin.* According to *Dr. Bostock* (*a*) this test is capable of detecting the three-millionth part of a grain in solution. A single drop will produce an immediate and copious dark-brown precipitation.

All the above precipitates, if rubbed on a bright plate of copper, will render its surface silvery white, in consequence of the amalgamation which takes place.

Brugnatelli has lately proposed a method of distinguishing *corrosive sublimate* from *arsenic*, which we have repeated to our satisfaction; but the experiment requires some nicety of manipulation to secure its success. Take a quantity of fresh wheat starch, mix with water, and add a sufficient quantity of *iodine* to give the liquid a blue colour; if either of the above poisons be now introduced into it, the colour will be destroyed, and assume a reddish tint; but if the change has been effected by the latter substance, a few drops of sulphuric acid will restore the blue colour; whereas if it has been produced by the former, it is not recoverable by such means. (*b*)

3. *It is dissolved in various coloured liquids.* Under this subdivision we have to consider the corrosive sublimate as existing in a state of solution, in liquids, whose colour will be liable to obscure the characteristic indications which the several reagents would otherwise occasion. It has been proposed to obviate such impediments by the previous addition of chlorine, which will discharge the colour in question. *Orfila* recommends such a process, where the salt has been dissolved in wine. The same objections which we urged against this mode of proceeding,

(*a*) Edinburgh Med. & Surg. Journal, v.
(*b*) Ann. de Chimie et Phys. iv. 334.

under the consideration of arsenic, appear to us to apply to corrosive sublimate.

It will be preferable on these occasions to precipitate the salt by an appropriate reagent, and then to assay the precipitate for metallic mercury; or to evaporate the solution, and to submit the matter so obtained to the process of sublimation, when the sublimate may be dissolved in distilled water, and examined by the tests above described. This circuitous process may, however, in many cases be rendered unnecessary, by dropping the solution on the surface of white paper, and in such a situation proceeding to its examination by tests; when the colour of the precipitate will rarely be exposed to any optical fallacy. The Galvanic process of metallic reduction will also furnish a satisfactory solution of the problem.

4. *It is mixed, or combined, with some medicinal body in a solid form.* As persons have been poisoned by empirical remedies, and other medicines containing sublimate, accidently or by design, it is necessary to point out the readiest mode by which the investigation may be pursued. If it should form part of a plaster, it will be adviseable to cut it up in small pieces, and boil them for a quarter of an hour in distilled water; this fluid, after standing for some time, should be filtered, and examined as we have before directed. It is evident that, if the sublimate is neither decomposed, nor strongly retained by the materials which compose the plaster, it ought to be found in the above solution; if, however, no such result can be obtained, the solid portion should be dried in a capsule, and mixed with potass; and in this state submitted, in the usual manner, to the process of sublimation, when the appearance of metallic globules

will announce the existence of the salt in question, or, at least, of the presence of some mercurial preparation.

5. *It is united with alimentary substances which have effected its decomposition.* It has been frequently stated during the course of the present inquiry, that corrosive sublimate is easily susceptible of decomposition, and that various alimentary substances, of animal as well as vegetable origin, have the power of converting it into *calomel.* (*a*) This important fact was first noticed by *Chaussier* (*b*) and has been more fully investigated and confirmed by *Orfila.* (*c*) Where the quantity of mercurial salt has been considerable, we may generally obtain, on washing the alimentary matter, a sufficient portion for experiment; but where the dose has been small, or where it has been ejected by frequent vomiting, the whole residue may be decomposed; in which case we must seek to establish the fact of poisoning, through the detection of metallic mercury, by the processes of calcination and sublimation.

6. *It is decomposed, and a part exists in intimate combination with the membranes of the alimentary canal.* If all the preceding experiments have failed in detecting the presence of corrosive sublimate, it becomes our duty to examine the textures with which it may be supposed to have come in contact; the coats of the canal should be cut into pieces, and calcined with potass, when, if they have been acted upon by sublimate, they will yield metallic mercury

(*a*) Tartarized Antimony, administered as an emetic, may decompose the salt in the stomach.

(*b*) Consultation Medico-legale sur une Accusation de l'empoisonnement par le *Muriate de Mercure sur-oxydé.* p. 146.

(*c*) L. C.

by sublimation. "The alimentary canal," says *M. Orfila*, "acts upon the sublimate like all other animal substances; muriatic acid is disengaged, and muriate of mercury *ad minimum* (*calomel*) is formed, which combines with the substance of the viscus.

It may be objected," continues this distinguished experimentalist, "that this chemical action does not take place in the living animal; that our texture, while endued with the vital principle, is not subservient to the same laws as inorganic substances: I am not ignorant of the extent to which this objection is well-founded; but admitting the justice of it, the conclusion is not less true, that if the stomach contains corrosive sublimate at the moment of death, this body will, from that moment, act on the texture of the viscus itself. If the stomach contain a large quantity of aliment, the effects of such an action may be scarcely perceptible; but on the contrary, they will be easily applicable, should the viscus be empty, and especially if the examination of the body takes place several days after death." (*a*)

In conducting experiments upon this, and indeed all other mineral poisons, the chemist must be prepared to meet with anomalies depending upon the impurities or adulterations of the substance under examination.

Red Oxide of Mercury. *Precipitate per se.*

We are not aware of any instance of death having, from accident or design, taken place in consequence of the administration of this substance; indeed its red colour, insolubility in water, and comparative

(*a*) The above passage is quoted from *Waller's* translation of *Orfila's* Treatise on Poisons, vol. i. p. 73.

rarity, will protect mankind sufficiently against mistake, and at the same time render its secret administration extremely difficult. It is, moreover, mild in its effects, unless in large doses, or, under particular circumstances of constitution. It may be identified by its form, which is that of minute crystalline scales, of a deep red colour, and by exposing it to heat in a glass tube, by which it undergoes decomposition, giving out metallic mercury, adhering to the sides of the tube, and oxygen gas, which is disengaged.

Red Precipitate, or *Nitric Oxide of Mercury.*

This is, strictly speaking, a *sub-nitrate* of mercury, and is much more poisonous than the preceding substance. *Plouquet* (*a*) relates the case of a man, who swallowed by accident some red precipitate, when he immediately experienced violent colics, copious vomitings, a trembling of his limbs, and cold sweats. Its external characters will at once enable the chemist to identify it.

Other Preparations of Mercury.

The various saline compounds of this metal, as the acetate, sulphate, and nitrate, are all highly poisonous, but they do not appear to us to merit a separate consideration; and more especially as we have already explained the various processes by which every variety of preparation may be identified. We may just remark that the *sulphuret*, better known by the name of *cinnabar*, or *vermilion*, has been known to occasion deleterious effects. *Dr. Gordon Smith* (*b*) states,

(*a*) Comment: Med. in Processus Criminales.
(*b*) Principles of Forensic Medicine, p. 113.

upon the authority of *Mr. Accum*, (*a*) that "Vermilion has been detected as a poisonous ingredient in cheese:" this may be very true, but he should have stated at the same time, that the deleterious effects produced by it, did not arise from the mercurial sulphuret, but from the red lead with which it happened to be adulterated; and it is necessary to acquaint the forensic chemist, that such a fraud (*b*) is by no means uncommon; it may be very easily detected by burning a small portion of the suspected sample on a piece of bread in the candle, when metallic globules will announce the presence of lead; for the oxide of mercury, although revived by the process, will at the same time be volatilized. The bread by combustion affords the carbon by which the metallic reduction is effected.

The presence of very minute quantities of *vermilion* may, according to *Mr. Smithson*, be detected by the following simple experiment. Boil a portion with sulphuric acid in a platina spoon, and lay the sulphate thus produced in a drop of muriatic acid, on a piece of gold, and then bring a piece of metallic tin in contact with both, when the white mercurial stain will be produced.

Antimony.

Although the ancients were entirely ignorant of this metal, they were well acquainted with several of

(*a*) *Accum* on culinary poisons, or "Death in the Pot." As this is the last occasion which we shall have to mention the above work, we may observe by the way, that this *ad captandum* title is not original with *Mr. Accum*, for there is a dissertation by *Mauchart*, entitled "Mors in Olla."

(*b*) Many of the preparations lately presented by *Dr. Baillie* to the College of Physicians have become black, in consequence of the vermilion, with which they are injected, having been adulterated with red red.

its combinations. (*a*) *Basil Valentine*, a German Benedictine Monk, was the first who described the process for obtaining it from its ore; to this work, originally written in high Dutch, and known by the title of the "*Currus Triumphalis Antimonii*," which was published towards the end of the 15th century, we are indebted for almost all our knowledge respecting this metal.

Antimony is of a greyish white colour, having considerable brilliancy; its texture is laminated, and exhibits plates crossing each other in every direction; its *specific gravity* is 6·7021; when rubbed upon the fingers it communicates to them a peculiar taste and smell; it is very brittle, and fuses at the temperature of 809°, but does not appear to be volatile; when fused, with the access of air, it emits white fumes, consisting of an oxide of the metal, which formerly was called *Argentine flowers of Antimony*. When the metal is raised to a white heat, and suddenly agitated, it enters into a state of combustion, and is converted into the same white coloured oxide.

According to *Thenard*, (*b*) antimony is susceptible of no less than six different degrees of oxidation; *Proust*, however, has shewn that they may all be reduced to two, viz. *protoxide* and *peroxide*. The former of which alone exerts any sensible activity upon the human body; but this constitutes the basis of several preparations, which although in common use for medical purposes, are so extremely poisonous in larger doses, as to render them objects of interest to the forensic physician.

(*a*) Upon this subject, the reader may consult the Historical Introduction to the Pharmacologia, page 87.

(*b*) Annal. de Chem. xxxii. 255.

Emetic Tartar. (*a*) *Tartarized Antimony.*

This saline body appears in the state of white crystals, whose primitive figure is the regular tetrahedron, although it assumes a variety of secondary forms. Its chemical composition is still involved in some obscurity; it is stated, in the different dispensatories, to be a triple salt, consisting of tartaric acid, oxide of antimony, and potass, and that it ought therefore, according to the principles of the reformed nomenclature, to be termed a *Tartrate of Antimony and Potass.* The truth of these views, however, we have already (*b*) ventured to question; *Gay Lussac* has stated that in the various metalline compounds of which *Super-tartrate of Potass* is an ingredient, this latter substance acts the part of a simple acid; an opinion which receives considerable support from the great solvent property of *cream of tartar*, and from the striking fact that it is even capable of dissolving various oxides which are insoluble in tartaric acid, of which the protoxide of antimony is an example. In such a state of doubt, a better name could not be found than that of *tartarized antimony.*

The salt, according to *Dr. Duncan*, is soluble in three times its weight of distilled water at 212° *Fah.* and in fifteen, at 60°.

When it is heated red hot in an earthen crucible, it blackens, and undergoes decomposition like a vegetable body, leaving a residuum of metallic antimony, and slightly carbonated potass.

(*a*) We have upon this, as well as on similar occasions, preferred adopting the name by which the substance is known in common parlance, to that which might more strictly accord with our scientific views of its composition.

(*b*) Pharmacologia, Edit. v. vol. 2. p. 65.

Symptoms of Poisoning by Emetic Tartar.

A question has arisen whether this salt can be considered as a poison, capable of occasioning death? In general where a large dose has been administered, it is all rejected by the vomiting which it excites; we accordingly find in the works of *Morgagni* and other pathologists, the history of various cases in proof of the innocence of this salt. *Hoffman*, however, relates the case of a woman who experienced very severe symptoms shortly after having taken tartar emetic, and that she ultimately died, (*a*) and there are other similar instances recorded in the works of *Foderé* and *Orfila*. It also deserves notice, that tartarized antimony is very liable to produce deleterious effects, where, from the insensibility of the nervous system, the operation of vomiting cannot be excited, as in apoplexy, drunkenness, and in that state of coma, which follows the ingestion of narcotic vegetables. *M. Cloquet* communicated to *Orfila* a case highly illustrative of this fact, in which a person, labouring under apoplexy, received into his stomach more than forty grains of tartar emetic, without exciting either nausea or vomiting. On opening the body, independent of the morbid state of the brain, which must be regarded as the immediate cause of death, extensive organic lesions were discovered in the alimentary canal, which could alone be attributed to the action of the tartar emetic. This fact will suggest a very important precaution to the practitioner, who may be called upon to treat a person labouring under a state of the system which will prevent the act of vomiting. (*b*).

(*a*) F. Hoffmanni Op. om. T. 1. par. ii. c. v. p. 219.

(*b*) This subject is treated very copiously in the first volume of the Pharmacologia, page 152. To this work the author must refer the

The symptoms produced by this salt will resemble those of a corrosive poison; and where vomiting is produced, it frequently happens that although the patient may be eventually saved, an irritability of stomach, so great as to cause the rejection of all aliments, will remain for a considerable period; and *Dr. Male* states that in the only case of poisoning by this salt which he had ever seen, the person was affected with violent convulsions, which returned at intervals for several weeks after recovery from the immediate effects of the poison. (*a*) *M. Orfila*, after detailing several cases of poisoning by emetic tartar, concludes by saying that the general symptoms, upon such occasions, may be reduced to the following: a rough metallic taste; nausea; copious vomitings; frequent hiccup; cardialgia; burning heat in the epigastric region; pains of the stomach; abdominal colics; inflation; copious stools; syncope; small, contracted and accelerated pulse; skin cold, sometimes intensely hot; breathing difficult; vertigo, loss of sense, convulsive movements; very painful cramps in the legs; prostration of strength,—death.

Sometimes to the above symptoms is joined a great difficulty of swallowing; deglutition may be suspended for some time. The vomiting and alvine evacuations do not always take place, the necessary consequence of which is an increase in the violence of the other symptoms.

Antidotes.

The great indication to be fulfilled in a case of this description, is the ejection of the salt by vomiting. *MM. Orfila* and *Berthollet* rely very confidently upon

reader, for the limits of the present volume will not allow more than a mere enunciation of the fact.

(*a*) Elements of Juridical Medicine, edit. 2, p. 96.

the effects of *bark, strong tea, infusion of galls,* and other *vegetable astringents,* which have undoubtedly the power of decomposing the salt. They ought, therefore, to be employed as diluents to assist vomiting, but they are not to be considered as antidotes which can render this latter operation less indispensable.

Physiological action of emetic tartar.

M. Majendie has shewn by experiment, that if *tartarized antimony* be injected into the veins of a dog, the animal vomits, and has frequent stools; his breathing becomes difficult; his pulse frequent and intermitting; a great degree of disquietude, and tremblings are the precursory signs of death, which generally takes place within the first hour from the injection of the emetic tartar. On opening the body great alterations are perceived in the lungs; they are found of an orange or violet colour, have no crackling, are distended with blood, and of a tight texture. The mucous membrane of the intestinal canal, from the cardia to the extremity of the rectum is red, and strongly injected.

If, instead of thus injecting the emetic tartar into the veins, it be injected into the stomach, and the œsophagus is tied to prevent vomiting, *M. Orfila* informs us that the same alterations will be found after death. The very same effects will also arise from the application of the emetic tartar to the different absorbing surfaces, such as the cellular substances, &c.

Mr. Brodie (*a*) has also thrown considerable light

(*a*) Further experiments and observations on the Action of Poisons on the Animal system, by *B. C. Brodie, Esq.* F. R. S. Communicated to the Society for the improvement of Animal Chemistry, and by them to the Royal Society." *Phil. Trans.* for 1812, vol. 102, p. 205.

upon the action of this salt. He observes that the effects of emetic tartar so much resemble those of *arsenic*, which we have already described, and those of *muriate of baryta*, which will form a future subject of inquiry, that it would be needless to enter into a detail of the individual experiments which he made with it. When applied to a wound in animals which are capable of vomiting, it usually, but not constantly, operated very speedily as an emetic; in other respects he found no material difference in the symptoms produced in the different species of animals, which he had been in the habit of employing as subjects of experiment. The symptoms were paralysis, drowsiness, and, at last, complete insensibility; the pulse became feeble, but the heart continued to act after apparent death, and was maintained in action by means of artificial respiration; but never for a longer period than for a few minutes. Whence it would appear, that this poison acts by being absorbed, and that it directs a sedative influence upon the heart, as well as the brain, but that its principal action is on the latter. The length of time which elapses, from the application of the poison to the death of the animal, varies; in some instances *Mr. Brodie* found that it did not exceed three quarters of an hour, but in others, it was two or three hours, or even longer, before death took place. When a solution of emetic tartar was injected into the stomach of a rabbit, *Mr. Brodie* observed the same symptoms to take place, as when it was applied to a wound.

Organic lesions discovered by dissection.

Mr. Brodie, in his examination of animals poisoned by *emetic tartar*, sometimes found the stomach bearing the marks of inflammation, but at other

times, its appearance was perfectly natural. In no case did he discover any traces of inflammation in the intestines. The reader must compare this account with that already given by *M. Majendie*, at p. 282.

1. *Tests for the detection of emetic tartar.*

1. *The poison is in a solid form.* Dissolve a portion of the suspected salt in about fifteen times its weight of boiling distilled water; if it be emetic tartar, the following reagents will identify it, viz.

(*a*) *The hydrosulphurets* will occasion a reddish-yellow precipitate, which is a combination of *oxygen* and *antimony*, proceeding from the emetic tartar; and of *hydrogen* and *sulphur*, from the reagent employed. If it be dried on a filter, and mixed with charcoal and the potass of commerce, it gives, by the action of heat, a cake of metallic antimony.

(*b*) *Tincture of galls.* This is regarded as the most sensible test of this salt, affording a precipitate of a curdled, dirty white colour, inclining to yellow.

(*c*) *Lime water.* This reagent produces a white precipitate, which is extremely thick, and is easily redissolved by pure nitric acid. In this case the lime forms an insoluble tartrate, and the tartrate of antimony, thus rendered insoluble, subsides along with it.

(*d*) *Concentrated sulphuric acid* gives a white precipitate, which consists of the oxide of antimony retaining a small portion of the acid. It redissolves in an excess of the precipitant.

(*e*) *Vegetable extractive*, occasions in the solution of this salt, a reddish-yellow precipitate, which has been found to consist of *oxide of antimony*, and a portion of vegetable matter.

2. *It is mixed with various alimentary substances.*

If our attempts should fail to procure a solution of the salt by filtration, answering to the above reagents, we must rely upon the proof of metallic reproduction. Various circumstances may invalidate the action of our tests, such, for instance, as the ingestion of some vegetable infusion or decoction, especially that of galls, or yellow bark.

With respect to the other preparations of antimony, it is unnecessary to waste our time in their consideration; the precepts already given will afford the practitioner every requisite hint for the prosecution of the enquiry.

Copper.

This metal, with the exception of gold and silver, and perhaps tin, was known earlier than any other metal; but its applications were entirely confined to the arts. It was first discovered by the Greeks in the island of Cyprus, whence its name; and we learn from *Homer*, that even during the Trojan war, the combatants had no other armour but what was made of bronze, which is a mixture of *copper* and *tin*. (*a*).

The external characters of the metal are too well known to require minute description. Its taste is styptic and nauseous; and the hands when rubbed for some time on it, acquire a peculiar and disagreeable odour. When melted, its specific gravity is 8·667; but after being hammered it is 8·9. It is only susceptible of two degrees of oxidation. If the pro-

(*a*) To those who are curious upon this subject, we recommend the perusal of an interesting essay, entitled "Observations on the Tin trade of the Ancients in Cornwall, and on the Ictis of Diodorus Siculus," by Sir *Christopher Hawkins*, Bart. F.R.S. &c.

toxide be *native*, it is red; if *artificial*, orange coloured. The peroxide is black.

Copper, on exposure to a moist atmosphere, becomes tarnished, absorbs a portion of its oxygen, and passes into the state of an oxide, which shortly unites with the carbonic acid of the atmosphere, and forms a greenish carbonate of copper.

Metallic copper, perfectly pure, does not possess any deleterious properties. We have already cited instances (*a*) sufficiently conclusive to establish this fact. It becomes, therefore, a subject of no little interest to enquire, under what circumstances it may become poisonous by combination. *M. Orfila* observes that it has been long maintained, that milk heated, or allowed to remain in vessels of copper not oxidized, dissolved a portion of this metal, and acted as a poison. *Eller*, a philosopher of Berlin, has, however, very clearly proved such an opinion to be incorrect. He boiled in succession, in a kettle well freed from verdegris, milk, tea, coffee, beer, and rain water; after two hours boiling, he found it impossible to discover, in any of these fluids, the least vestige of copper. *M. Drouard* has also shewn that distilled water, left for a month together on the filings of this metal in a glass bottle, did not dissolve an atom of it. The celebrated toxicologist above cited, after relating these important facts, concludes by observing, that the phenomena are very different, if, instead of pure water, we substitute that which contains a certain quantity of muriate of soda. *Eller* has demonstrated the presence of a very small quantity of copper in water, which contained $\frac{1}{20}$th of its weight of

(*a*) See page 144 of this volume; and article *Cupri Sulphas* in Pharmacologia, vol. 2, p. 167, *note*.

muriate of soda, and which had been boiled in a brass kettle. This fact is of the highest importance, for it will explain the reason why highly seasoned aliments have proved deleterious, when cooked in vessels of copper. But we are indebted to *Mr. Eller* for a still more important discovery; he found that if, instead of heating a simple solution of common salt in copper vessels, the salt be previously mixed with beef, bacon, and fish, the fluid resulting from it does not contain an atom of copper. (*a*) In relating this fact, *M. Orfila* observes, "however astonishing it may appear, it is quite correct, *M. Eller* was the first to announce it, and I have several times ascertained the truth of it; it is probable," continues *Orfila*, "that the combination of several kinds of aliments destroys the effect of the solution of the muriate of soda; which consequently ought to render the cases of poisoning by aliments cooked in copper vessels, *which are not oxidized*, extremely rare."

Copper combines with sulphur, and affords a black sulphuret.

Oxide of Copper.

By oxidation, copper becomes poisonous. The substance may be easily recognised by the change of colour which it produces in ammonia; this alkali will dissolve it instantly, and assume a beautiful blue colour. It is wholly insoluble (*b*) in water. In oils

(*a*) We have long considered that the process of salting meat is something more than the mere saturation of the animal fibre with muriate of soda; some unknown combinations and decompositions take place, which future experiment will probably discover.

(*b*) Water may thus be preserved in copper cisterns, without contracting any metallic impregnation, even should the surface of the cistern be coated with the oxide and carbonate of copper.

and fatty matter it is easily and copiously dissolved at the ordinary temperature of the atmosphere. Such bodies also, when boiled in vessels of perfectly clean copper, facilitate their oxidation, especially if left to cool a few minutes before they are poured out.

Green Carbonate of Copper— *Natural Verdegris.*

This substance forms spontaneously on surfaces of copper and brass; it differs from the oxide in its green colour, and in effervescing with dilute sulphuric acid; with ammonia, however, it demeans itself in the same manner, and is likewise insoluble in water. It is poisonous.

From the above history of these substances the medical practitioner will easily perceive under what circumstances, and by what bodies, metallic vessels of copper may be rendered dangerous. The oxide and carbonate, formed in them, will easily dissolve in acidulous and oily aliments, whence it follows that all preparations of such food, if conducted in vessels whose surfaces have contracted this change will be liable to prove deleterious. (*a*) If the vessels be perfectly clean, acid preparations may be safely boiled in them, but they must be poured out immediately, and not suffered to remain sufficiently long to allow the copper to become oxidized. To the formation of the oxide of copper, and to the acetic acid contained in the wine, vinegar, beer, and cider, *M. Orfila* attributes the production of the *acetate* which forms

(*a*) *Dr. Johnson*, in his Essay on Poison, relates the history of three men being poisoned, after excruciating sufferings, in consequence of eating food cooked in an unclean copper vessel, on board the Cyclops frigate; and, besides these, thirty-three men became ill from the same cause.

about the corners of the cocks in vessels containing these liquors. Upon the same principle the *soda water* sold in this town, in a draught, from the pump, is liable to metallic impregnation, as we have fully satisfied ourselves.

Equally important is it for the forensic physician to be acquainted with the various other sources from which copper poison may be derived. In consequence of the fact of the oxide of copper forming, with the acids, compounds of a beautiful green colour, the metal is often employed in cookery to impart a vivid hue to various articles; the sale of pickles, for instance, frequently depends upon the liveliness of their green colour; whence we find, in works (*a*) on cookery, directions for ensuring such an effect, by boiling the pickles with copper coin, or by suffering them to stand for some time in vessels of that metal. In the third volume of the *Medical Transactions of the College of Physicians* we shall find an interesting history, related by *Dr. Percival* of Manchester, of a young lady who amused herself, whilst under the hands of the hair-dresser, with eating pickled samphire, of which she consumed two breakfast plates full; she shortly afterwards complained of great thirst, pain in the stomach, and a rash appeared upon her hands and breast. After an illness of nine days, during which she suffered severe vomitings, and tormina of the bowels, she expired. Upon examining the samphire, *Dr. Percival* found that it was very strongly impregnated with copper. In the preparation of confectionary, especially sugar-plums, and sweatmeats of a green colour, copper is very gene-

(*a*) See the Ladies Library, vol. ii, p. 203; Modern Cookery, or the English Housewife, edit. 2, p. 94; and the English Housekeeper, p. 352, 354.

rally introduced, and many instances are recorded of their having proved highly deleterious. Catsup is also said to be occasionally impregnated with verdegris; and vestiges of this metal have been detected in the well known cordial, called *Shrub*.

In order to prevent the *contingent* dangers attendant upon copper vessels, they ought always to be *tinned;* (*a*) and it is a very curious and interesting fact, that this latter metal, although it may cover the copper surface only imperfectly, will nevertheless protect us from its effects; for *M. Proust* has shewn that the superior readiness with which *tin* is oxidized and acted upon by acids, when compared with copper, will not allow this latter metal to appropriate to itself a single atom of oxygen.

But copper vessels, notwithstanding this fact, unless well tinned, should be dismissed from the service of the kitchen. The Senate of Sweden, in the year 1753, prohibited them entirely, and ordered that none but such as were made of iron should be used in their fleets and army.

Verdegris. *Ærugo.*

The verdegris of commerce is a compound mass, consisting of the acetate, and sub-acetate of copper, carbonate of copper, and copper partly metallic, and partly oxidized; it, moreover, contains the stalks of grapes and other extraneous matter. Boiling water dissolves it in part, and, at the same time, occasions in it a chemical change, by transforming one portion of the *sub*-acetate into the soluble acetate, and another, into an oxide of copper, which is precipitated. With cold water, verdegris demeans itself very differently; the acetate is dissolved by it, whilst

(*a*) This practice is of ancient origin, thus *Pliny* "Stannum, illinitum æneis vasis, saporem gratiorem facit, et compescit æruginis virus." Lib. xxxiv, cap. 17.

that portion which is in the state of *sub*-salt remains suspended in the form of a fine green powder. Vinegar converts all the *ærugo* into a soluble acetate. Sulphuric acid poured on its powder decomposes it with effervescence, and vapours of acetic acid are disengaged; a character by which this substance may be easily identified.

Blue Vitriol. *Sulphate of Copper.* *Blue Copperas—Roman Vitriol.*

This salt occurs in crystals of a deep rich blue colour, and whose form is that of a rhomboidal prism; their taste is harsh, acrid, and styptic; on exposure to air they slightly effloresce, and assume a greenish hue. When treated with sulphuric acid, no effervescence occurs, a circumstance which at once distinguishes this salt from *ærugo*.

Symptoms of Poisoning by the Salts of Copper.

The operation of these bodies, upon the human system, is betrayed by an acrid, styptic, coppery taste, in the mouth; nausea; head-ache; a dry and parched tongue; vomiting; coppery eructations; a cutaneous eruption; violent pains in the bowels; very frequent alvine evacuations, sometimes green, and often bloody and blackish; great and painful distention of the abdomen; small and irregular pulse; heat of skin; ardent thirst; difficult and laborious respiration; hiccup; syncope; cold sweats; convulsions—death. It does not, however, kill so speedily as arsenic, or corrosive sublimate.

Organic Lesions discovered on Dissection.

Where death has been speedily produced by a cupreous poison, dissection will generally discover

inflammation, and even gangrene in the mucous membrane of the alimentary canal. Like other poisons of the corrosive class it will also be found to have occasionally extended its inflammatory action to all the coats of the canal, producing sloughs, easily detached, and leaving perforations. *Dr. Male* has also remarked that inflammation will sometimes be observed in the brain; but that this is not an universal effect of copper poison. It has been stated, that the fluids contained in the *primæ viæ* are, upon these occasions, very frequently tinged with a green colour.

Chemical Tests by which the presence of the preparations of Copper may be detected.

1. *The suspected body is in a solid form.*—We have already pointed out the characters by which the principal preparations of copper may be identified. Our judgment, however, upon these occasions will require that confirmation from experiment, which the following processes are calculated to afford.

A. *By its reduction to a metallic state.* If the copper presents itself in the form of an oxide, it may be easily reduced by heating it, in the usual manner, in contact with some carbonaceous matter; an earthen crucible will furnish the most convenient vessel for the occasion. If the substance has been scraped from a surface of copper, it is probably in the state of carbonate, *(natural verdegris,)* and may be calcined with charcoal in order to procure the metal. Should the substance in question be true *ærugo*, we may at once heat it to redness in an earthen crucible, when, without the aid of any carbonaceous matter, we shall obtain metallic copper.

B. *By the application of certain reagents, or tests, to its solutions.*

It may happen that the quantity of the above substances is not sufficient to allow their metallic reduction by calcination. In that case, we must proceed to obtain a solution; but since neither the oxide, nor the carbonate, is soluble in water, it will be necessary to bring them in contact with concentrated acetic acid, so as to obtain an acetate of copper; which will furnish the following indications with the respective tests.

a. A surface of clean iron. If dipped into the solution will become coated with metallic copper, and appear as if transmuted into that metal.

b. Ammonia. This test, when added in a quantity more than sufficient to saturate any excess of acid, will strike a beautiful blue colour; in the first instance we shall obtain a deep blue precipitate, but this will be redissolved by an excess of alkali. To detect the presence of copper, therefore, in pickles, it is only necessary to cut them into small pieces, and to pour liquid ammonia, diluted with an equal bulk of water, over them in a stopped phial: if the pickles contain the most minute quantity of this metal, the ammonia will assume a blue colour. In the same manner cupreous impregnations may be discovered in the various articles of confectionary above enumerated, and in those foreign conserves which are imported into this country, and usually sold in round boxes.

c. Sub-carbonate of Potass. By this re-agent a precipitate of a pale blue colour is produced.

d. Arsenite of Potass instantly occasions a copious

precipitate in the acetate of copper, which is of a green colour, and is in fact an arsenite of the metal.

e. Triple Prussiate of Potass. This test gives a brown precipitate with a solution of verdegris, which is found to consist of prussiate of copper, and prussiate of iron; while the liquor contains an acetate of potass.

2. The suspected poison is mixed and combined with various alimentary substances.

We have in this case the same embarrassments to encounter, as those already noticed under the consideration of arsenic. Our tests may produce their respective precipitates, but they will present different colours according to the nature of the fluids with which the substance happens to be mixed; whence the circumstance of colour, so characteristic on other occasions, cannot be received as a satisfactory indication. In such a difficulty, we may collect the precipitates, and calcine them in a crucible with charcoal, in order to obtain the metal; or we may at once evaporate the whole of the alimentary mass, and submit it to a high temperature, by which means all the vegetable and animal principles, which can form a part of the liquor vomited, will be decomposed and converted into several volatile productions, and into charcoal; this combustible body will decompose the oxide of copper, and reduce it to its metallic state. (*a*).

Nor is this process without its fallacies; it is often difficult to recognise the metal, dispersed as it necessarily must be, in small quantity, through a considerable mass of charcoal; in this case we are recom-

(*a*) *Orfila*, l. c.

mended by *Orfila* to place the product of the calcination in water, when in a short period, the copper, from its superior specific gravity will subside from the lighter particles of charcoal. But it would be still better to pour nitric acid upon the product of the calcination, and thereby to obtain a solution of *nitrate of copper*, which by filtration might be immediately prepared for the application of appropriate re-agents.

It merits notice, however, that in certain cases of poisoning by copper, no vestiges of the substance can be found in the matters voided from the stomach. In that case, *Orfila* directs that the mucous membrane of the stomach, and of the intestines, should be scraped off, dried, and submitted to the action of a strong heat in a crucible. "I have," says this distinguished experimentalist, "twice obtained metallic copper, by calcining in this manner a portion of the membranes of the stomach of two dogs that I had poisoned with verdegris. This effect particularly takes place when the mucous membrane is of a bluish colour, hard, and strongly adhering to the substance of the stomach.

Tin and its Muriate.

It is clearly established by the experiments of *Bayen* and *Charlard*, (*a*) as well as by those of *Proust*, (*b*) that this metal possesses no poisonous properties. Its muriate, however, has been shewn by *Orfila* to possess highly corrosive properties. It excites violent vomiting, great depression, and death, without convulsions. Its antidote is milk, which it speedily coagulates; and by chemical combination

(*a*) Recherches Chimiques sur l'Etain, par *Bayen et Charlard*, 1781.
(*b*) Annales de Chimie.

with it, the poison is rendered inert. On dissection, the stomach is said to have been found corrugated and indurated, and has been compared to tanned skin, but its colour is not altered.

As this substance is never likely to become an object of forensic interest, in this kingdom, we shall pass it over without farther notice.

Zinc.

The ancients were acquainted with a mineral to which they gave the name of *Cadmia*, (*a*) from Cadmus, who first taught the Greeks to use it. They knew that when melted with copper it formed brass; and that when burnt, a white spongy kind of ashes was volatilized, which they used in medicine. (*b*) This mineral contained a good deal of zinc; and yet there is no proof remaining that the ancients were acquainted with that metal. It has a brilliant white colour, with a shade of blue, and is composed of a number of thin plates adhering together; its specific gravity is 7·1. When strongly heated in a crucible, it quickly goes into fusion, absorbs the oxygen of the atmosphere, and burns with a beautiful white flame, inclining to green, and extremely brilliant. The oxide of zinc thus formed, is diffused through the atmosphere, and is there condensed into extremely light flakes of a beautiful white appearance. This oxide was formerly known under the fanciful names of *nihil album; lana philosophorum*, &c.

In its metallic state it is quite inert; but late experiments by *Vauquelin* and *Deyeux*, have proved that it is very easily acted upon by water, the weakest

(*a*) See *Thomson's* System of Chemistry.
(*b*) Plinii Lib. xxxiv. cap. 2, 10.

vegetable acids, some saline substances, and butter; a fact which is hostile to the proposal of employing this metal for the manufacture of culinary utensils.

White Vitriol. *Sulphate of Zinc.*

This salt occurs in masses, consisting of crystals which are four-sided prisms, terminated by four-sided pyramids. Their taste is styptic, metallic, and slightly acidulous. They are soluble in 2·5 times their weight of water at 60°, and in less than their own weight of boiling water, but they are quite insoluble in alcohol. Thus dissolved they redden the tincture of tournesol.

Symptoms of Poisoning by Sulphate of Zinc.

This salt, like tartarized antimony, from the high degree of emetic virtue which it possesses, generally proves its own antidote; still, however, it must be considered as a poison; for several cases are on record, where the most alarming symptoms, and indeed death itself, have been the effect of its ingestion. *Metzger* (*a*) mentions the case of a woman, who accidentally ate a trifling quantity of a cake, into which *White Vitriol* had been introduced for the purpose of shortening the days of an old man. The woman died; but the intended victim escaped, after severe vomiting. *M. Orfila* has also related several cases of poisoning by this salt. The symptoms which presented themselves on these occasions were, an astringent metalline taste, a sense of constriction in the fauces, so distressing as even to excite in the patient a fear of

(*a*) We extract the notice of this case from Dr. *Gordon Smith's* work, not having a copy of Metzger's Principles of Judiciary Medicine at hand.

suffocation; frequent vomitings; copious stools; pains in the epigastric region, extending afterwards over the whole abdomen; difficulty of breathing; frequency of pulse; paleness of the countenance, and coldness of the extremities.

We have lately heard of a case in which a noble lord swallowed a solution of white vitriol, which had been sent to him by mistake, for Epsom salts, to which it bears some analogy. Fortunately, however, the violent emetic effect which followed removed the poison from the stomach, and obviated any farther injury.

Organic lesions discovered on Dissection.

We have no well authenticated dissection of a human being who had died from the ingestion of this poison. The examination of animals (*a*) who have been so killed has shewn nothing more than an inflammation, not very severe, of the membrane with which it had come in contact; sometimes dark blood is observed to be extravasated upon the muscular coat of the stomach and intestines.

Chemical processes for the detection of Sulphate of Zinc.

The chemist must remember that the *White Vitriol* of commerce always contains sulphate of iron, and sometimes sulphate of copper. When dissolved in distilled water it may be identified by the following re-agents; *viz.*

a. Potass, and *Ammonia*, precipitate an oxide of a greenish white colour, easily soluble in an excess of the latter of these alkalies. The oxide obtained by potass, being washed and dried, and calcined with

(*a*) *Orfila*, l. c.

charcoal, is revived, provided the temperature be very much elevated. It should be known, that if the salt has been previously purified, the above tests will occasion a *white* precipitate.

b. Prussiate of Potass produces a precipitate of a rather deep blue colour; which, consists of a mixture of the prussiates of zinc and iron. If the salt has been divested of all impurity, the precipitate will be white.

c. The Hydro-sulphurets instantly occasion a blackish precipitate, which, like the former, will be found to be a mixture of zinc and iron, in the state of an hydro-sulphuret. If the salt, however, is pure, its colour will be white with a tinge of yellow.

Silver.

This metal does not exert any influence on the living body; but its oxide in combination with nitric acid constitutes one of the most corrosive of all the metallic salts.

Lunar Caustic. *Nitrate of Silver.* *Lapis Infernalis.*

The usual state in which this substance occurs is in that of small cylinders, having been cast into moulds for the purpose of imparting to it a form best adapted for the purposes it is designed to answer.

Its action on animal matter is highly caustic, and when introduced in any considerable quantity into the stomach, will induce death by corroding the texture with which it may come in contact. At the same time there is reason to believe that the whole, or part of its composition, may be absorbed; for we have many instances on record where the frequent

repetition of this metallic salt, in small doses, has imparted a blue tinge to the skin, which can only be explained on the supposition that the oxide of the metal has been actually deposited in the rete mucosum (*a*).

We are not aware that there is any modern case of poisoning by this salt (*b*). The medical practitioner, however, ought to know, that common salt, is its true antidote; indeed so completely does it decompose and separate it from water, that if a saturated solution of nitrate of silver be filtered through common salt, it may be afterwards drunk with impunity. *M. Orfila*, by a series of experiments, has shewn that if the *muriate of soda* be administered a very short time after the ingestion of lunar caustic, it will disarm it of its virulence by transforming it into an insoluble muriate, possessing no power of acting on the animal œconomy.

Chemical processes for the detection of Lunar Caustic.

If a small portion of the salt can be procured it may be dissolved in distilled water, and immediately identified by the following tests.

a. Muriatic acid, or any soluble Muriate, will precipitate the muriate of silver, which is white, curdled, very heavy, insoluble in water, or nitric acid; but soluble in liquor ammoniæ; when exposed to the air it acquires a black colour.

(*a*) Pharmacologia, vol. ii. art. *Argenti Nitras.*

(*b*) *Boerhaave* relates the instance of a student in pharmacy having swallowed some lunar caustic, in consequence of which the most serious symptoms resulted, such as excruciating pains, gangrene, and sphacelus of the primæ viæ. *Metzger* also mentions a case, where a piece of lunar caustic was accidentally dropped into the throat of a person while applying it to an ulcer, but that the patient was saved by drinking copious draughts of milk.

b. Potass, Soda, and *Lime water,* will occasion a precipitate of the oxide, of a deep brown colour.

c. Ammonia. This alkali will form an *ammoniuret of silver,* and in consequence of the solubility of this new product, little or no disturbance is occasioned by the test.

d. Arsenite of Potass. As all re-agents must be considered as reciprocal in their operation, it is hardly necessary to state that this is one of the best tests for nitrate of silver. See the history of its effects at p. 240.

If it should be necessary to discover the nitrate of silver amongst the fluids vomited, or those contained in the stomach of the deceased, we are very properly directed by *M. Orfila* to filter, and then assay by the appropriate tests; if, however, the different aliments should disguise the characteristic colour and appearance of these precipitates, we must proceed to desiccate and calcine them in order to obtain the silver in a metallic state.

The Concentrated Acids.

These must be regarded as the most terrible of all corrosive poisons. Their action is so immediate and energetic, as generally to destroy the membranes of the stomach, before their peculiar antidotes can be applied. Notwithstanding the obvious suffering they must occasion, and the facility with which they may be detected, such bodies have frequently, especially in France, been the instruments of suicide and murder; whilst in this country, we have had many lamentable illustrations of their deadly force, by their ingestion from fatal carelessness. In conformity with our general plan we shall proceed to consider the individual substances included under

this general class, although the symptoms do not materially differ in the different kinds, nor are the indications of cure peculiar to any of them. There are however chemical characters which exclusively belong to each acid, with which the forensic physician must be accurately acquainted, in order that he may be enabled to detect their presence.

Oil of Vitriol. *Sulphuric Acid.*

This acid, when perfectly pure, exists in the form of a colourless liquid, without smell, and of an oily consistence; whence its popular name. Its specific gravity is 1·85, so that, in round numbers, it may be stated that an ounce, by measure, will weigh fourteen drachms. It acquires a brown tinge from the smallest portion of carbonaceous matter; mere exposure to the atmosphere is sufficient to effect this change, in consequence of the acid disorganizing and carbonating the vegetable and animal matter suspended in the air. This fact sufficiently explains why we generally find the acid of commerce of a brown colour.

Its taste is highly acid and caustic. So powerful is its affinity for water, that upon its admixture with this fluid, a heat, sufficiently great to boil water, may be produced. When exposed in its concentrated state to the air, it will imbibe at least seven times its own weight of water, and so rapidly as to have its weight doubled in a month. Straw, wood, and all vegetable substances, when immersed in the sulphuric acid, without heat, are disorganized, softened, and blackened, and there is separated from them a certain portion of charcoal. Like the other mineral acids, the *Oil of Vitriol* has never been obtained in an insulated state without water; according to the latest

views of *Sir H. Davy*, the composition of the strongest acid may be expressed as follows. Sulphur 30, oxygen 45, water 17.

Symptoms of Poisoning by Oil of Vitriol.

An extremely austere, acid, and burning taste; a painful heat in the fauces and throat, along the œsophagus, and in the stomach; excruciating pain; nausea, and excessive vomiting; at one time the fluid vomited is as black as ink, at another reddened by arterial or venous blood, producing in its passage through the throat, the most intense pain, accompanied with a sensation of bitterness quite intolerable; if, by chance, a portion of it should fall on the hearth or pavement, or on any other calcareous substance, it will denote its true nature by an effervescence; constipation, or sometimes bloody stools; gripes and excruciating pains over the abdomen, with a tenderness of these regions, so exquisite as not to allow the slightest pressure without torment; pains of the breast; difficulty of breathing; extreme anxiety; the pulse becomes frequent, small, contracted, and irregular; shiverings; great restlessness, dejection, and agitation; convulsive motions of the countenance; sometimes a cutaneous eruption betrays itself. Amidst all these symptoms, the intellectual powers remain unobscured. The parts about the fauces, the uvula, &c. having lost their vitality, slough, and become detached, which occasion an indescribable fetor of the breath, while they produce a perpetual cough, and the voice becomes so altered, that it resembles the sounds of a person labouring under croup.

Organic lesions discovered on Dissection.

As this substance destroys life by simply acting as an escharotic, it is not difficult to anticipate the disorganization which dissection will display. The extent of the lesion, however, must in every case depend upon the quantity and degree of concentration of the acid, the state of the stomach in relation to its alimentary contents, and other incidental circumstances not to be exactly appreciated. The mucous membrane of the mouth, the tongue, and œsophagus, will in general be found destroyed, and converted into a pulp.

Antidotes.

The great indications to be fulfilled in this distressing case, is the immediate dilution, saturation, and expulsion of the poison. Copious draughts of water, holding calcined (*a*) magnesia in suspension, should be administered without any loss of time. If this is not in readiness, soap and water should be administered; mucilaginous drinks, milk, and even warm or cold water, in the absence of more eligible potations, should not be neglected. It must be never forgotten, exclaims *Orfila*, that success upon these occasions depends upon the activity of the practitioner; the delay of a few moments will entirely change the fate of the patient, as the sulphuric acid destroys the texture of the organs with a fearful celerity. After having thus neutralized the caustic, it will be our duty to obviate the effects it may be

(*a*) In the neutralization of acid poisons in the stomach, it is a great object to avoid *carbonated* alkalies and earths, on account of the large volume of carbonic acid, thus given off, proving highly distressing.

likely to occasion; the lancet must be used with boldness, and the detraction of blood repeated at short intervals; at the same time emollient clysters may be advantageously injected.

Chemical processes for the detection of Oil of Vitriol.

In the pure state, there can exist no difficulty in identifying it; its specific gravity, and its action on vegetable matter, will, without any other tests, be quite sufficient to fulfil our object. If heated with metallic mercury, it will disengage sulphurous acid gas; and if united with lime, a sulphate of lime will be produced, which the chemist may easily recognise by dissolving a portion in distilled water, and assaying the solution by *muriate of baryta*, which will produce with the sulphate a precipitate, insoluble in nitric acid. By the last mentioned tests we shall be enabled to detect the presence of sulphuric acid, in whatever state of complication it may happen to exist with alimentary matter.

Nitric Acid.

This acid, when pure, assumes the form of a limpid fluid, emitting white fumes of a suffocating odour; its taste is highly acid, and corrosive; and it is at once distinguished from all other acids, by its tinging the skin indelibly yellow. When of the specific gravity 1·5 it contains 74·895 per cent of dry acid, (whose ultimate elements are one proportional of nitrogen, and five of oxygen) the complement 25·105 parts, is water. (*a*) It is decomposed with violent action by all combustibles, and when mixed with volatile oils it causes their inflammation.

(*a*) Pharmacologia, vol. ii, art. *Acid Nitric.*

From the facility with which this acid undergoes decomposition, it is rarely found in commerce in a colourless condition; indeed the action of light is sufficient to impart a tawny tinge to it; when this change has proceeded to such an extent as to render the acid orange coloured, it is called *Nitrous acid*, or, in the language of the arts, *aqua fortis*, although in a chemical point of view, such a nomenclature is incorrect, for it is nothing more than nitric acid, holding nitrous acid gas loosely combined.

Symptoms of Poisoning by Nitric Acid.

This acid has been so frequently swallowed in France, for the purpose of committing suicide, that it has enabled the pathologists of that country to afford a very satisfactory account of its operation, and effects. To *M. Tartra* we are particularly indebted for a very full and interesting investigation of the subject, and we shall avail ourselves upon the present occasion, of the many facts and observations with which his treatise (*a*) abounds. In describing the symptoms occasioned by the ingestion of this acid, *M. Tartra* establishes four different gradations, viz. 1, When the death is speedy, for it is never sudden, it commonly takes place from the *primary* effects in about twenty-four hours, varying from six to forty-eight hours. 2. When it proves fatal from its *secondary* effects, at different intervals, from fifteen days to several years. 3. When death does not take place, but the recovery is imperfect. 4. When a perfect cure is sooner or later obtained. The first case is illustrated by the

(*a*) Traité de l' Empoisonment par l'Acide Nitrique; par *A. E. Tartra*, Médecin. à Paris 1802.

following example, which will serve to convey a very just idea of the progress and intensity of the symptoms. "A man, driven by distress to commit suicide, under the greatest agitation of mind, and upon an empty stomach, swallowed, at a draught, two ounces of concentrated nitric acid. Instantly he was seized with the most excruciating pains and agitation, and could not lie in bed, but rolled himself upon the floor. Vomiting came on, accompanied by a general sensation of coldness, especially in the extremities. Every time he vomited, the matter effervesced upon the pavement. A solution of soap and oil was administered to him, and in two hours he was brought to the hospital, often having vomited, and stopped on the road to drink. On his arrival, he had emollient drinks, especially linseed tea, in great abundance. He was in continual agitation, and his countenance was greatly altered. He now vomited every instant a blackish glairy matter; he opened his mouth easily, and his tongue was white, with a tinge of yellow; he complained of acute pains in his mouth, along the œsophagus, and in his stomach. His belly, slightly tense, could not bear the slightest pressure, without great torment. The surface of the body was cold; the pulse small and frequent; he had hiccup, and the respiration was laborious.

His symptoms increased. He uttered sighs and lamentations; his limbs became icy; a cold sweat covered his whole body; his pulse was scarcely perceptible; the pain was constant; still he could rise and make continual but useless efforts to quench his thirst, and satisfy his urgent desire to void urine, and go to stool. He continued in this state during the night; the matters vomited became more clear,

and of a yellow colour. He at last made a few drops of urine. The shocking appearance of his body already resembled that of a corpse, but he retained his senses, and was speaking when he expired, nineteen hours after swallowing the acid." The burning heat and pains which are commonly the immediate effects of the ingestion of this acid are very variable in their intensity and duration, and *M. Tartra* observes that, in general, they are not in proportion to the quantity or strength of the acid swallowed. It often happens that persons who have taken only a small dose, are seized with the most excruciating and dreadful pains, and some of those who have swallowed a great quantity, two or three ounces for example, have had scarcely any suffering, but remained very tranquil. In the first case, the patients either recover, or survive a long time; in the second, speedy death is almost always the consequence; thus a young man of twenty died in twenty hours, without any agitation or signs of acute pains. On opening the body, the highest degree of disorganization appeared, perforations of the stomach, and great effusion of its contents into the abdomen. The second variety of the progress and termination of poisoning by nitric acid, exhibits, at first, the same phenomena as the preceding; but less alarming symptoms succeed by degrees; after some months, the inner membrane of the alimentary canal detaches itself in portions, the patient falls into a marasmus, and dies. We are here presented with a case of *consecutive* poisoning, see *page* 147.

The third termination is in imperfect recovery. A slow and progressive amendment ensures the safety of the patient; but there still remains some complaint; obscure pains in the throat, and especially in

the epigastric region; habitual constipation, occasional vomiting, and increased sensibility of the stomach, so that it can only support light nourishment and bland liquors; in short, they continue invalids during the rest of their lives; they are subject to repeated and even habitual indispositions, and sometimes to pain and insupportable heat of the stomach; but they are able to follow their occupations, and long survive their poisoning.

The total disappearance of the symptoms produced by swallowing nitric acid; or complete and absolute recovery without leaving any consequences, is the last variety of termination.

Organic lesions discovered on Dissection.

Tartra has furnished us with the following interesting account of the dissection of those who have died of the primary effects of nitric acid. The external appearance of the body presents no alteration; every part is sound and natural, and possesses, in a certain degree, the firmness and freshness of life. The epidermis of the margins of the lips has commonly an orange colour, more or less deep. It seems burnt and easily separates. Sometimes yellow spots are discovered on the hands and other parts of the body, caused by the contact of the acid. A yellow fluid, in some cases very abundant, flows from the mouth and nostrils, and the belly is considerably distended with air. The alimentary canal is remarkably affected. All the internal membrane of the mouth is burnt, and has sometimes a white colour, but is more commonly yellow; it is separate in some places, and adheres in others. The teeth are often loose, and have a very marked yellow colour at their *crown*.

The mucous membrane of the pharynx exhibits the same change, or is in a state of inflammation of a dirty red colour. The whole extent of the œsophagus is lined with a dense mass of a fine yellow colour, dry on its surface, unctuous and greasy to the touch, and which seems to be formed both of the mucous membrane, altered in a particular manner, and of the albumen contained in the viscid fluid which exudes from the membrane of the œsophagus, solidified by the nitric acid. This lining adheres in very few points, and is easily detected from the other membranes of the œsophagus, which are brown and blood-shot. When the stomach is not perforated, it has commonly a considerable size; externally, its membranes are slightly and partially inflamed, but very much towards the pylorus and beginning of the duodenum. Its colour is faded, livid, of a yellowish green, with large gangrenous spots. It adheres every where to the neighbouring parts, the diaphragm, liver, spleen, and transverse arch of the colon, by means of a concrete lymphatic exudation; its sides, which are thin and yellow in some places, and thick and black in others, exhibit net-work of dilated blood-vessels filled with black coagulated blood. Often there are several points of the stomach dissolved, and ready to burst with the slightest touch; it contains a great quantity of gas, which has a peculiar smell, resembling that of bitter almonds; it also very commonly contains a great quantity of yellow matter, of a pultaceous consistence; the substance of the stomach is generally swelled in some places, and deeply marked with black, without being dissolved; this effect is most remarkable at the great end, into which the acid seems to fall by its weight; the rugæ of the stomach are very brown, and are reduced to a muci-

laginous consistence. The other parts of the alimentary canal exhibit the same organic lesions, although the phenomena have less intensity in proportion as the part is more distant from the stomach.

In those cases where the stomach is found perforated, its bulk is very small; the holes commonly occur in the large and small extremities; their form is circular, and their edges thin, and as if dissolved. The urinary bladder contains no urine, although the patient have not discharged any.

The appearances upon dissection of those who die of the *secondary* effects are entirely different from those above described. It would be difficult to find an example of greater emaciation, more advanced consumption, or more disgusting form. Nothing is equal to the degree of withering, and decrepitude of the whole organs; their colour is faded; the internal cavities do not contain the usual serum; the cellular and muscular systems are almost annihilated; the bones become dry, as in persons of advanced age, and break with extraordinary facility; but these changes are general and secondary, and depend upon local organic derangement of the alimentary tube. The stomach and whole intestinal canal are contracted to an extremely small size; the intestines are not larger than the little finger, sometimes not exceeding a thick writing quill; their coats are very thick, their cavity almost obliterated, and containing only a little mucosity. The stomach, which often resembles a portion of a small intestine, appears sound externally, and only presents some adhesions to the neighbouring viscera; internally, the most remarkable change is the contraction of the pylorus, the passage through which will scarcely admit a probe; and the membranes of the stomach itself are so thickened and com-

pacted around it, that they have lost all their natural suppleness. On the internal surface, there are irregular spots, or rather smooth and red places, which seem to be covered with a regenerated mucous membrane, less villous than that which had been destroyed by the action of the acid; these cicatrices are particularly large and numerous in the great end of the stomach, and around the circumference of the pylorus.

Chemical processes by which the presence of Nitric Acid may be discovered.

If the acid be in any quantity, and without mixture, there cannot exist any difficulty in demonstrating its presence. If added to copper filings, there will be a copious disengagement of orange-coloured fumes, and a nitrate of copper of a blue colour will remain, as the product. If it be saturated with potass, we shall at once obtain by due evaporation the well known substance, nitre; this salt will announce its nature by deflagrating with charcoal or sulphur. This latter test is the one we must employ for the detection of nitric acid, when mixed with vinegar, and other liquids. Where the acid has combined with the animal matters with which it may have come into contact, they must be boiled for an hour in a solution of pure potass, when the solution will assume a reddish appearance; this must be filtered, and evaporated in a capsule of porcelain, when the mass so obtained will leave a residuum of nitrate of potass.

Dr. Marcet, in a paper just published in the *Philosophical Transactions*, (*a*) on the composition of sea

(*a*) Some experiments and researches on the saline contents of sea-water, undertaken with a view to correct and improve its chemical analysis. By *A. Marcet*, M.D. F.R.S. in the Phil. Trans. for the year 1822. part 2.

water, employed a new mode of assaying the solution for nitric acid, and for which he acknowledges himself indebted to *Dr. Wollaston.* Having concentrated the *bittern* in a glass vessel, until it began to deposit solid matter, he added sulphuric acid and gold leaf, and boiled the mixture; the gold leaf was not in the least acted upon, nor was any smell of nitric acid perceived; but on adding the smallest quantity of nitre to the same mixture, the gold was dissolved, and the smell of *aqua regia* instantly perceived. The rationale of the experiment is obvious, gold, although insoluble in muriatic acid, is instantly dissolved on the addition of nitric acid, in consequence of the developement of chlorine.

Spirit of Salt. *Muriatic Acid.*

The liquid acid, of which we are about to treat, is a solution of muriatic acid gas in water; when of the specific gravity 1·16, according to *Davy*, it contains 32·32 per cent. of the gas, which recent experiments have proved to be a compound of *Chlorine* (oxy-muriatic acid) and *hydrogen*, in equal volumes. It has accordingly received a name expressive of its composition, and is called *Hydro-chloric acid.* Its odour is strong and peculiar; when exposed to the air it emits white fumes; its taste is intensely sour and caustic; it is, however, the weakest of the three mineral acids, and no remarkable elevation of temperature is produced by dilution. It readily combines with potass, soda, &c. and furnishes a class of salts which may be easily recognised by their characters.

Symptoms of Poisoning by Muriatic Acid.

As the effects of muriatic acid do not differ from those which have been described, as the consequences

of poisoning by the other mineral acids, it will be unnecessary to enumerate them. *Orfila*, however, remarks, that the patients who have swallowed a certain quantity of it, emit, in the first moments of the accident, a thick smoke of a white colour, and very pungent smell.

Chemical processes for the detection of Muriatic Acid.

This acid, in its free state, immediately announces its nature by the fumes which it emits. When the acid, however, exists in a more questionable shape, as in the matter vomited by the patient, or in that found in the digestive canal after death, it will be necessary to saturate the liquid part with pure potass, and to boil it for some time, when we shall obtain a fluid, from which the nitrate of silver will throw down a dense precipitate. By evaporation, we shall obtain a crystallized muriate, which may be identified by the following tests: 1, When concentrated sulphuric acid is poured upon it, a brisk effervescence is immediately occasioned, and the muriatic acid is disengaged in the form of white vapours, which are thick, and of an excessively pungent smell. 2, If instead of employing concentrated sulphuric acid, this acid be used in a state of dilution, and the muriate be mixed with some substance which easily yields its oxygen, the muriatic acid will be decomposed, its hydrogen, combining with the oxygen so as to form water, while the chlorine will be disengaged, and by its pungent and peculiar odour at once announce the nature of the acid under examination.

Oxalic Acid. *Acid of Sugar. (a)*

This salt occurs in small crystals, whose form is that of a four sided prism. It is extremely acid to the taste, so that by applying the tongue to one of its crystals, its nature may be immediately discovered. It dissolves in twice its weight of cold, and in an equal weight of hot water; it is also soluble in boiling alcohol which takes up about half its weight; the solutions act powerfully on the vegetable colours, and at once denote their acid properties. On account of the strong resemblance which the crystals of this acid bear to those of sulphate of magnesia, or *Epsom* salts, many fatal accidents have occurred. We are not aware that it is ever purchased, in retail, for any other purpose than as a detergent, to clean the tops of boots; in the large way, it is an article of extensive trade with the calico printers. Its salts (*b*) are likewise employed for various purposes in the arts.

Amongst the many schemes which have been proposed to secure the public against the possibility of mistaking this acid for Epsom salts, there does not appear to be one which admits of successful application; nor are we able to propose any test of discrimination which is not far inferior in accuracy and convenience, to that which is afforded by the mere taste of the crystal; indeed we cannot understand how so

(*a*) It is known in commerce by this name, since it is prepared on a large scale, by distilling sugar with nitric acid. It derives the term *oxalic* acid, from the plant which so abundantly contains it, viz. *oxalis acetosella*, or wood sorrel.

(*b*) Essential Salt of Lemons. "The preparation sold under this name, for the purpose of removing iron moulds from linen, consists of cream of tartar, and super-oxalate of potass, or *salt of sorrel*, in equal proportions." *Pharmacologia.*

acid a solution can be swallowed, without an immediate discovery.

Symptoms of Poisoning by Oxalic Acid.

From the history of the many cases on record, it appears that this acid produces all the grievous symptoms, which characterise the action of a corrosive poison; its operation upon the stomach is similar to that of any other powerful acid; and dissection displays the same destruction of parts, as that we have already described under the consideration of the mineral acids.

Antidotes.

We should endeavour to form as quickly as possible an insoluble oxalate of lime; copious draughts of lime water, or magnesia and water, should be administered; and vomiting immediately excited.

Chemical tests for the detection of Oxalic Acid.

If any of its crystals can be obtained, we shall be immediately able to identify them. They dissolve very readily in water, and since the oxalic has a greater affinity for lime, than any other acid, and forms an insoluble salt with it, we have thus a ready test of its presence, for it will decompose all the calcareous salts, not even excepting the sulphate.

Boiling Water.

Many cases are recorded of the death of children from the ingestion of boiling water; an accident which will be always liable to occur, as long as the peasant allows his family to quench their thirst by drinking the cold water through the spout of the tea kettle. It has been very generally supposed that fatal

effects have, on these occasions, supervened the high state of inflammation produced in the æsophagus and stomach by the boiling liquid. *Dr. Marshall Hall* has, however, lately published a very interesting paper on this subject, in the twelfth volume of the *Medico-Chirurgical Transactions;* from which it would appear, that the patient, under these circumstances, actually dies of suffocation as in croup; and that the boiling water is arrested in its progress to the stomach by the convulsive action of the muscles of the pharynx. In passing, however, to the posterior part of the mouth, it scalds the *epiglottis*, and *glottis*, which afterwards become more and more swollen, until at length the *rima glottidis*, or orifice into the larynx, becomes completely obstructed. Here then we have a new instance in which the operation of laryngotomy, or of tracheotomy, may be performed with the effect of preventing impending suffocation, and perhaps of saving life. *Dr. Marshall Hall* relates four cases in illustration of this interesting fact; of which one recovered from imminent suffocation immediately after screaming (*a*); two died from suffocation, one 10, the other 17 hours, after the accident; the fourth was completely relieved by the operation of tracheotomy, and survived 34 hours, but died, exhausted by the irritation produced by the primary affection.

Melted Lead.

An instance stands recorded in the history of the destruction of the Eddystone-light house, by fire, where a quantity of melted lead fell into the mouth,

(*a*) The parents of this child suppose that the violence of the screaming ruptured the vesicles by which the breathing was impeded, and thus proved an unexpected means of cure.

and was swallowed by a person who was attentively watching the conflagration. It is very singular, that this man lived many days after the accident; a fact which at least shews what extensive injury the stomach will occasionally sustain, without the immediate destruction of life. The lead taken out of the stomach after death, in this case, weighed exactly seven ounces, five drachms, and eighteen grains. (*a*)

The Caustic Alkalies.

These bodies are distinguished by a highly corrosive and peculiar taste; they change the blue (*b*) juices of vegetables to a green, and the yellow to a brown; they are soluble in water, and have the power of imparting the same property to oils, by combining with them, and thus forming saponaceous compounds. With the different acids they constitute peculiar salts. When applied to the flesh of animals they act as powerful caustics, destroying its texture, and ultimately dissolving it; they are accordingly arranged with great propriety under the head of corrosive poisons.

There are three (*c*) alkalies—*potass*, *soda*, and

(*a*) See "An account of the case of a man who died of the effects of the fire at Eddystone Light-house, by Mr. *Edward Spry*, Surgeon, at Plymouth. Phil. Trans. vol. xlix, part 2, p. 477, A. D. 1756.

(*b*) There are some exceptions to this law; for instance, the tincture of litmus, and litmus paper, are always rendered more intensely *blue*, by the addition of alkalies. There are also other bodies, besides alkalies, which change the yellow colour of turmeric to a brown. Upon this subject see an interesting paper in the 26th number of the Journal of Science and the Arts, p. 315, by *Mr. Faraday*, entitled "On the changing of vegetable colours as an alkaline property, and on some bodies possessing it." By this communication we are informed that even the strong acids redden turmeric paper, and that a very weak nitric acid gives it a tint exactly like that produced by an alkali. Different metallic salts are characterised by similar effects.

(*c*) A new alkali has been lately discovered in a mineral called *Petalite*, by *M. Arfwedson*, a young Sweedish chemist, but as the extreme ra-

ammonia. To the two former the epithet *fixed* has been applied, since they require a very high temperature for their sublimation; while to the third, that of *volatile* has been assigned, because, when uncombined, it exists in a state of gas. *Potass*, as it was considered the product of vegetation, has received the name of the *vegetable* alkali, while *soda*, as the base of rock salt, has been distinguished by that of *mineral* alkali. The distinctions, however, originally established by *Avicenna*, must now be abandoned, for they have not the slightest foundation in truth; *potass*, so far from being the exclusive product of vegetation, exists as a constituent part of the *Granite*, which forms the foundation of our globe; it has also been discovered in the *Pumice stone;* in some minerals of the *Zeolite* family; in the *Leucite;* in the aluminous ores of *La Tolfa*, &c. and, although potass is undoubtedly procured by lixiviation from the ashes of burnt wood, and other vegetable substances, yet there is ample grounds for supposing that the living plant receives it from the soil in which it vegetates.

Potass, or *Potash*—

Liquor Potassæ—Potassa Fusa, or *Kali Causticum—Lapis Infernalis—Causticum commune acerrimum.* Potassa cum Calce—Potassæ Sub-carbonas, or *Salt of Tartar—Potash—Pearl ash.*

Potass is rarely met with in a pure form, except in the laboratory of the philosophical chemist, and is

rity of the substance will prevent its ever becoming an object of forensic interest, we shall pass it over without further notice. Some new alkaline principles have also been developed by the French and German chemists, in the analysis of certain vegetables, but as these bodies have a physiological action, which is wholly independent of their alkalinity, they will be more properly noticed under the history of the vegetables which contain them.

therefore not likely to become an object of judicial enquiry; but in various states of mixture, as presented in the different preparations above enumerated, it may become the accidental, as well as criminal means of poisoning; we shall therefore consider the chemical history of these different preparations separately, and then describe the symptoms which they generally occasion.

Liquor Potassæ.

This may be considered as a nearly pure solution of potass, although, as it is usually prepared, it contains small portions of *muriate* and *sulphate of potass*, *silica*, and *lime*. It is a limpid, dense, colourless solution; when rubbed between the fingers it feels soapy, in consequence of a partial solution of the cuticle. As it constitutes a medicine in common use, and, moreover, forms the basis of many *quack medicines*, as well as of those preparations which are sold under the name of *Depilatories*, it may readily become the accidental instrument of mischief.

Chemical Tests for its detection.

There cannot exist any difficulty in this investigation; its highly alkaline characters will be immediately announced by its effects on the vegetable test papers, and by its power of saturating acids; while the particular species of alkali may be readily identified by the following reagents.

(*a*) *Carbonic acid;* or *water saturated with the gas.* This will not produce any (*a*) disturbance in the so-

(*a*) Should the solution contain a small portion of lime, as may occasionly happen, the cloud will be very slight, and cannot give origin to any important fallacy.

lution of potass; a fact which at once serves to distinguish this alkali from the earths, *baryta* and *lime*.

(*b*) *Deuto-muriate of Platina* occasions a canary-yellow precipitate, consisting of the deutoxide of platina, potass, and muriatic acid; as this precipitate is, to a certain extent, soluble in water, the test may fail through dilution. With soda, this reagent will not occasion any precipitate, a fact which depends upon the solubility of the triple salt formed, and affords an easy method of distinguishing the fixed alkalies from each other.

(*c*) *Tartaric acid.* If an excess of this acid be added, we shall obtain crystals of a *bi-tartrate*; a phenomenon which will not take place if soda be the alkali employed.

Potassa Fusa, or *Kali Causticum.*

This substance, which occurs in sticks, or cylinders, is an extremely caustic and deliquescent substance; it is principally employed in surgery, to establish an ulcer; or, instead of incision, to open a tumour. See *Pharmacologia.* As it differs from potass, only in the degree of purity, it is unnecessary to offer any farther remarks.

Potassa cum Calce.

This is a mixture of the preceding substance with lime, which is added with a view to diminish the deliquescent property of the alkali, and thus to render it more manageable as an escharotic. There will be no difficulty in separating these ingredients. Their different solubilities will furnish an easy mode of effecting it to a certain extent, and we may then pre-

cipitate the remaining portion of lime, by carbonic acid.

Sub-carbonate of Potass—Salt of Tartar—Pearl-ash—Potash.

Although potass becomes comparatively mild, by its union with carbonic acid; yet the present preparation retains so much causticity as to render it poisonous, if administered in any considerable dose. *Plenck* reports a case of this kind, where a patient having swallowed an ounce of *salt of tartar*, was shortly afterwards seized with a violent vomiting, which continued for forty-eight hours, followed by a violent inflammation of the stomach; from which, however, he ultimately recovered.

Symptoms of Poisoning by any of the above preparations of Potass.

A styptic, urinous, and caustic taste; a severe heat in the throat; violent vomiting, generally of alkaline matter, turning the syrups of violets green, and where the alkali has been in the state of *carbonate*, effervescing with acids; sometimes the matter thus ejected is mixed with blood; copious alvine evacuations; severe pain in the epigastric region; excruciating tormina of the bowels; depravation of the intellectual faculties, and death. It will be easily perceived that the above symptoms merely indicate the operation of a corrosive poison. They offer no characteristic peculiarities which can enable us to decide upon the particular substance that has been swallowed, unless, indeed, the matter vomited can be submitted to examination.

Antidotes.

From the experiments of *Orfila*, it appears that vinegar, diluted with water, is the remedy which can be administered with the greatest success, where any preparation of this alkali has been swallowed in a poisonous dose.

Organic lesions discovered on dissection.

In consequence of the peculiar action of this alkali upon animal matter, we shall generally find the stomach perforated, and its coats extensively dissolved. We shall moreover discover the usual indications of violent inflammation in this viscus, as well as in the intestines.

SODA.

We have already stated by what chemical reagents this alkali may be distinguished from *potass*; it only remains for us to observe that its physiological action, the symptoms arising from its ingestion, and the organic lesions discovered on dissection, are strictly analogous to those we have described as the effects of potass.

AMMONIA, and its CARBONATE.

Ammonia, in its uncombined state, exists in the state of gas, and is incapable of application; its affinity, however, for water, enables it to combine with that fluid, and to form liquid ammonia, (*Liquor Ammoniæ*) in which state it is useful in medicine, and in the arts. This solution is colourless; its taste extremely caustic; and its odour strong, pungent, and peculiar. Exposed to the action of heat, the ammoniacal gas

is driven off, and may be recognised by its characteristic odour, as well as by its effects upon moistened *turmeric* paper. When brought into contact with muriatic acid, it will form dense white vapours, consisting of *muriate of ammonia.* A most elegant and sensible test for ammoniacal gas is afforded by a mixed solution, consisting of arsenious acid and nitrate of silver; these substances when mixed in solution do not occasion the least disturbance in each other, for reasons already explained, (see page 240) but upon spreading a portion of the liquid upon glass or paper, and bringing ammoniacal gas into contact, a beautiful yellow cloud immediately diffuses itself over the surface of the solution.

Sub-carbonate of ammonia occurs in solid, white, semi-transparent masses, of a highly pungent and ammoniacal odour. Its chemical composition has been found to vary materially according to the circumstances under which it has been prepared; *Mr. R. Phillips*, who has made some highly interesting experiments upon this subject, considers the *sub-carbonate* to be a *sesqui*-carbonate, composed of 3 atoms of carbonic acid, 2 atoms of ammonia, and 2 of water. By long exposure to the air, its pungency is lost, and it is converted into an inodorous carbonate.

Symptoms of poisoning by Ammonia.

Cases wherein death has been produced in a few minutes, from the ingestion of liquid ammonia, stand recorded on the authority of *Martinet*, *Huxham*, *Haller*, and other physiologists. In such cases the lips, tongue, and fauces are described as being burnt by the causticity of the fluid; while hemorrhage of the intestines marks the organic lesions which it occa-

sions. The nervous system would appear also to suffer greatly, at the same time that the abdominal organs are affected with violent inflammation.

The Caustic Alkaline Earths.

Under this division, we have to consider the two earths, *Lime* and *Baryta;* both of which are highly corrosive, although they essentially differ from each other in their physiological action. In this respect they may be compared to *corrosive sublimate* and *arsenic*, and offer an additional illustration of the imperfection of the present classification; for while *lime* acts as a local caustic upon the parts with which it comes in contact, *baryta* will require, for its action, to be absorbed and carried into the current of the circulation.

Quick Lime.

This earth is of a white colour, and of a hot caustic taste; with acids it forms peculiar salts; a fact which we shall shew affords the most decisive means of identifying its presence. It changes vegetable blues to a green, and reddens *turmeric;* it is capable of fusion; so great is its affinity for water, that it will absorb and solidify one third of its weight of that fluid, and yet remain perfectly dry. The heat, therefore, that is evolved in the process of slacking lime, evidently proceeds from the water, which yields its caloric, as it passes from the liquid to the solid state.

Symptoms of poisoning by Lime.

It is perhaps the least energetic of the corrosive poisons; and yet, when taken in any quantity, it will

produce nausea, vomiting, colics, frequent stools, and all the symptoms which characterise, or are complicated with, inflammation of the stomach and intestines. (*a*) Lime in combination with carbonic acid is not considered as poisonous.

Organic lesions discovered on dissection.

In examining the body of an animal that has been killed by caustic lime, we shall find the mucous membrane of the stomach reddened, and evincing marks of inflammation in those parts which have been in contact with it.

Tests for the detection of Quick-lime.

We may proceed, if the substance be free from mixture, to obtain a solution of the earth in distilled water, and to assay it by the following reagents.

(*a*) *Carbonic acid, and the soluble alkaline sub-carbonates* produce a copious white precipitate, which is soluble in an excess of carbonic acid. The *carbonate of lime*, of which this precipitate consists, is also decomposed by muriatic acid, with effervescence, a soluble muriate remaining.

(*b*) *Oxalic acid, and oxalate of ammonia.* They precipitate lime-water of a white colour, and the resulting *oxalate* is not soluble in an excess of acid.

(*c*) *Sulphuric acid.* This acid does not precipitate lime water, since the *sulphate of lime* formed does not require more than 300 parts of water to dissolve it. Whereas, says *M. Orfila*, the smallest quantity of an exceedingly diluted solution of *baryta* becomes instantly turbid on the addition of that acid, because

(*a*) *Orfila*, vol. i, p. 404.

the *sulphate of baryta* is insoluble in several thousand times its weight of water. By this test, therefore, we are at once enabled to distinguish lime-water, from barytic water.

Baryta, and its Salts.

Baryta, like lime, is a solid, heavy, alkaline earth, having an acrid and peculiar taste; and turning the syrup of violets *green*, and the juice of turmeric *red*. When perfectly calcined, it absorbs water very rapidly, disengaging at the same time a quantity of caloric; the phenomenon is similar to that of *slacking lime*, and admits of the same explanation. It dissolves in about 20 parts of water, at the temperature of 60°; but boiling water will dissolve half its weight of this earth, part of which will crystallize on cooling.

Muriate of Baryta. This salt crystallises in square plates, or four-sided prisms; its taste is acrid and pungent. It dissolves in $2\frac{1}{2}$ parts of distilled water at 60° *Fah.* The solution is limpid and colourless, and has been employed in medicine, as a remedy in scrofula, cancer, some forms of syphilis, and in hectic fever connected with ulceration. *Dr. Johnstone* says that he has seen a delicate female take as much as thirty drops of a saturated solution of this salt, *repeatedly*, without nausea; whence he concludes that it would require at least 2 or 3 drachms to do mischief. (*a*)

Symptoms of poisoning by Baryta.

All the soluble compounds of this earth are poisonous, especially the *muriate*; which, whether injected

(*a*) Essay on Poisons, page 143.

into the veins, introduced into the stomach, or externally applied to an abraded surface, will occasion death in a very short period. We are not aware that any case stands recorded of poisoning by baryta. *Orfila* (*a*) and *Brodie* (*b*) have, however, investigated the symptoms which this poison produces on animals, and they appear to be analogous to those occasioned by the ingestion of arsenic. The muriate, on account of its greater solubility, would appear to be much more active than the pure earth, or its carbonate.

Physiological action of Baryta.

Barytic poisons require to be absorbed before they act on the system; they may therefore destroy by external application, although it would appear that, unlike arsenic, they act sooner when internally administered. *Mr. Brodie* thinks that the *muriate of baryta* occasions death by acting upon the brain and the heart; at the same time it exerts a local action, and corrodes the viscus with which it comes into contact.

Antidotes.

It has been shewn by the experiments of *Orfila*, that the soluble sulphates, as *Glauber* or *Epsom salts*, by converting the *baryta* into an insoluble *sulphate*, will act as antidotes to its virulence. In the first instance, therefore, it will be prudent to produce this chemical decomposition in the poison, and then to expel it, as quickly as possible, by emetics.

(*a*) *Orfila*, Lib. Cit.
(*b*) *Brodie*, Phil. trans. 1812.

Chemical tests for the detection of Baryta.

Where the pure earth, *baryta*, or its solution in water, is presented for our investigation, it may be identified by the following reagents.

(*a*) *Sulphuric acid, and the soluble sulphates.* These bodies precipitate from the barytic solution, a white *sulphate* of the earth, insoluble in water, and nitric acid.

(*b*) *Carbonic acid gas, and the alkaline sub-carbonates*, produce in it a white *carbonate of baryta.*

(*c*) *Muriatic acid* combines with baryta, and furnishes a salt which is capable of being identified by numerous reagents. *M. Orfila* has furnished us with the following satisfactory compendium of its habitudes. "A salt which does not redden the tincture of tournesol, which does not turn the syrup of violets green, which is not precipitated by the alkaline hydro-sulphurets, (*a*) nor by ammonia; but which, on the contrary, is precipitated by the sub-carbonate of ammonia, soda, or potass; which is not soluble in concentrated alcohol; which furnishes, with the sulphate of potass, or the sulphuric acid, a white precipitate insoluble in water and in the nitric acid, and which gives with the nitrate of silver a curdled precipitate of muriate of silver, likewise insoluble in the nitric acid, *can be no other than the muriate of baryta.*

But it may happen, that the above salt is so mixed with alimentary matter, as to defy the action of the tests; in this case we must endeavour to obtain from it the pure earth, by precipitating the suspected fluids

(*a*) This is an important characteristic, since all the metallic poisons yield an abundant precipitate, either black, yellow, or red, on the addition of one or other of the alkaline hydro-sulphurets.

by the sub-carbonate of ammonia; when a *carbonate of baryta* will fall down, which must be dried on a filter, and calcined with charcoal.

Cantharides. *Spanish Flies—Blistering Flies.* (*Cantharis Vesicatoria*, Sp. 1, of Latreille. (*a*)

Cantharides are imported into this country in their entire state, and are so kept in the shops; their form and general appearance are too well known to require description, and they will rarely become the objects of inquiry; in powder, however, they may be presented to us for investigation, and it is therefore essential that the forensic physician should be acquainted with the appearances which they assume in the state of disintegration. This powder has a greenish colour, tinged with grey, and abounding with shining points of a very beautiful green colour, and which may be recognised in whatever state of division the powder may exist, even after it has passed through a silken sieve. Its odour is acrid and nauseous; when thrown on burning coals it emits that peculiar smell, which generally attends the destruction of animal matter by heat. The chemical history of *cantharides* is still involved in some obscurity; according to *Robiquet*, who has furnished us with the most satisfactory analysis, they contain various fatty principles; the phosphates of lime, and magnesia; and the acetic and uric acids; together with a peculiar crystalline principle, in which the vesicatory properties wholly reside, and to which the name of *cantharidin*

(*a*) "Genera Crustaceorum et Insectorum," tom. 2, p. 220. The London College in their present pharmacopœia refer this insect to the genus Lytta, an error which will be corrected in the future edition.

has been given by *Dr. Thomson.* (*a*) It may be obtained in plates, having a micaceous lustre; when perfectly pure it is insoluble in water, but it is rendered soluble in that fluid, by the presence of a yellow matter which exists in native combination with it; it is very soluble in oils.

Symptoms of poisoning by Cantharides.

As this substance forms an article of the materia medica, it may become an accidental source of poisoning; whilst a general belief in its aphrodisiac powers may induce a trial of its efficacy, to goad the exertions of exhausted nature, or to incense the passion of females, whose seduction is meditated. In the annals of crime in this country, we are acquainted with but few instances in which cantharides have been given with the view of destroying life; we have already referred (*b*) to the case of *Vaux*, who was executed for poisoning with cantharides; there is also that of *Sir Thomas Overbury*, who, on the confession of the person who gave it to him, is said to have taken it, mixed with his sauces. Cantharides may be administered in the form of powder, infusion, or tincture. The following may be considered the more prominent symptoms which will follow the ingestion of a large dose. Violent retching; copious alvine evacuations, frequently bloody; very severe colics; active inflammation of the stomach and intestines; sometimes universal convulsions, attended with a horror of liquids, resembling that which occurs in hydrophobia; furious

(*a*) System of Chemistry, edit. 5, vol. iv. p. 436. See also Ann. de Chim. lxxvi. p. 308.

(*b*) Page 139, *note.*

delirium, &c. But the affections of the urinary passages, and organs of generation, may be regarded, κατ' ἐξοχήν, as the peculiar symptoms of poisoning by cantharides; such as heat in the bladder, bloody micturition; horrible strangury; painful and obstinate priapism; *satyriasis*, &c. If the dose has not been sufficient to occasion speedy death, it may produce marasmus.

Organic lesions discovered on dissection.

Where the poison has been administered internally, we shall find the stomach and intestines presenting an appearance of inflammation, very similar to that which we have described as the general result of corrosive poisons. Marks of inflammatory action, and sometimes ulceration, will be also discovered in the urinary and genital organs; especially in those cases where the person dies shortly after the ingestion of the poison.

Methods of detecting the presence of Cantharides.

Where the poison has been administered in substance, we shall generally discover some of its particles mixed with the ejected matter; or, after death, adhering to the coats of the stomach, or to the folds of the intestines, and which may be easily identified by their peculiar green and brilliant hue. If the poison should have been administered in the form of infusion, or tincture, our chemical resources will fail us, and we must rely alone upon the evidence furnished by the symptoms, and organic lesions.

Phosphorus.

This singular substance was accidentally discovered by *Brandt*, a chemist of Hamburgh, in the year 1669, (*a*) as he was attempting to extract from human urine a liquid capable of converting silver into gold. It was also subsequently discovered by *Kunkel* and by *Boyle*, without these latter chemists having, in any way, participated in the researches of each other.

Phosphorus, when pure, is semi-transparent and of a yellowish colour; but when kept some time in water, it becomes opaque externally, and then has a great resemblance to white wax. Its consistence is nearly that of wax; it may be cut with a knife. Its mean specific gravity is 1·770. It generally occurs in sticks. When exposed to the air, provided the temperature be not lower than 43°, it emits a white smoke, which has the smell of garlic, and is luminous in the dark. This smoke is more abundant, the higher the temperature is, and is occasioned by the gradual combustion of the phosphorus. When heated to 148° it takes fire, and burns with a very bright flame, and gives out a great quantity of white smoke, which is phosphoric acid. Oils dissolve phosphorus, provided the temperature be a little raised. Water has no effect upon it, unless it be aerated, when it renders the surface of the phosphorus opaque and white, which in a short time becomes red. This change depends upon oxidation.

Symptoms of poisoning by Phosphorus.

This substance, whether introduced into the stomach in its pure form, or dissolved in oil, will occa-

(*a*) *Homberg*, Mem. Par, 1692.

sion the most violent symptoms, from its escharotic action. (*a*) It has been employed in medicine, (*b*) in a state of minute division, in the dose of one-fourth of a grain, and is said by *Leroi* to be very efficacious in restoring and establishing the force (*c*) of young persons exhausted by sensual indulgence, and of even prolonging the life of the aged. (*d*) It has also been given as a stimulant in local fevers. We are, however, greatly inclined to question the safety of such a practice, notwithstanding the diminutiveness of the dose. The reader will find some interesting cases of poisoning by phosphorus, translated from the German work of *Weickard*, in *Hooper's* Medical Dictionary, under the consideration of that article. Should such a case present itself for the investigation of the forensic physician, he will not find any difficulty in identifying the substance; its external character, its smell, and, above all, its peculiar property of yielding luminous vapour, are too palpable and distinctive, to admit the possibility of error.

Mechanical Poisons—*Powdered glass—Enamel powder—Chopped hair, &c. &c.*

We have already examined the pretensions of these bodies to the rank of corrosive poisons, (*page* 145) and we should have not reverted to the subject, but from a wish to introduce the account of "*a case of*

(*a*) Ann. de Chim. xxvii, 87.

(*b*) The earliest account we have of this substance having been used in medicine is to be found in the seventh volume of *Haller's* collection of Theses, relating to the history and cure of diseases. The original dissertation is entitled "*De Phosphori loco Medicamenti adsumpti virtute medica, aliquot casibus singularibus confirmata, Auctore J. Gabi, Mentz.*

(*c*) Memoirs of the Society of Emulation at Paris.

(*d*) See *Nicholson's* Journal iii, 85.

Schirrus in the intestines, arising from hairs remaining in the canal," as related in the *Edinburgh Medical Journal*, (*a*) by *Dr. Burrell*, and which had, on the former occasion, escaped our notice. The subject of this history, *Laurence Harding*, æt. 35, being a private soldier, was admitted into the regimental hospital, for an unrelenting constipation of the bowels; but it appears also that he had been affected with dyspeptic symptoms, and pain in his abdomen, for several years; which pain was aggravated by the ingestion of solid food. He received but little benefit from the remedies that were administered, his strength gradually declined, and, about a month after his admission, he expired.

"On laying open the abdomen, the stomach was found much thickened throughout its whole substance, and the pylorus very much contracted, which contraction continued down the duodenum. Through all the intestines this thickening and gristly appearance was observed. The colon was prodigiously enlarged in its calibre, until where it forms its sigmoid flexure; at which point there were three distinct holes ulcerated through the coats of the intestine, and forming a communication with the abdominal cavity. Beyond the sigmoid flexure the intestine was contracted in its diameter, so as hardly to admit the little finger to pass downwards. On cutting open the pylorus and small intestines, the internal coats were found to be covered with a soft substance, which resembled size. The internal coats of the colon were of a dark colour, and in general were completely ulcerated, and hanging in shreds. The colour of the colon was of a dark lurid red. At the sigmoid flexure

(*a*) For July, 1813.

there was much contraction, and the thickening was so great on one side, and the valve found so considerable, as hardly to admit a common bougie through it. The portion forming the sigmoid flexure was cut out; and on laying it open, and removing some hardened fæces, *five or six hog's brittles were seen distinctly crossing each other in different directions;* they were partially invested in the villous coat, which had grown over them, and which had retained them in the different positions in which they were placed; and so firmly were they kept down by those partial coverings, that it required some force to draw them out. The mesenteric glands were of a cartilaginous appearance; the liver was suffused with blood, and the gall-bladder full of bile. The spleen was very small, and compressed into an oblong shape, probably arising from the pressure of the colon when distended with feculent matter.

This man had formerly been a shoemaker. There was no evidence as to the period at which he swallowed these hairs; but, from the derangement which always existed in the bowels, and the pain referred to the sigmoid flexure, little doubt can be entertained but that these hairs were the cause of all his complaints, and ultimately of his death."

CL. II. ASTRINGENT POISONS.

Lead.

This metal appears to have been known in the earliest ages; and is mentioned several times by *Moses.* (*a*) It has a bluish-white colour; is very brilliant when first cut with a knife, but soon tarnishes by

(*a*) Numb. xxxi, 22

exposure to air; when rubbed violently, it emits a peculiar smell; it is malleable and ductile, but possesses very little tenacity. It is scarcely sonorous; being the softest of all the metals, it yields readily to the hammer. Its specific gravity is 11·35; it melts at 612°. According to the experiments of *Dr. Thomson*, (*a*) it is susceptible of four degrees of oxidation, presenting us with four distinct, and well defined oxides, viz.

Yellow (*protoxide*) contains of lead	91·5	oxygen	8·5
Yellow (*deutoxide*)	90·5		9·5
Red .. (*tritoxide*)	88·		12·
Brown. (*peroxide*)	80·		20·

Lead, in its metallic state, does not exert any action on the living system; but, when oxidized, or in the state of salt, its virulence is very considerable, producing a train of symptoms, so peculiar to itself, as to justify our placing its preparations in a separate class, under the title of *astringent* poisons, as explained at page 202.

Metallic lead, although *per se* inert, may occasion deleterious effects when introduced into the stomach, in consequence of its meeting with acids in the *primæ viæ;* from the same cause, liquids which are liable to become in any degree acidulous, if kept in leaden vessels, may be productive of much danger to those who drink them. Pure water, provided the air be excluded, does not appear to exert any sensible action upon this metal; but the combined influence of these agents converts the lead into a carbonate: a fact which is at once exemplified by the white line which is so constantly visible at the surface of the water pre-

(*a*) System of Chemistry, 4th edit. I, 274—277.

served in leaden vessels. So well acquainted were the ancients with this fact, that we find frequent allusions in their works to the dangerous property of leaden utensils. *Vitruvius* (*a*) published a very strong remonstrance against leaden pipes, when used for the purpose of conveying water; and *Galen* cautions us continually, not to employ water that has flowed through pipes of this metal; since he had observed that the *sediment* of such water, (ὑποςάθμη τοῦ τοιούτου ὕδατος) rendered such as swallowed it, δυσεντερικὰς, subject to disorders in the intestines.

Dr. Lambe, to whom we are indebted for an important work (*b*) upon this subject, states, that there is a great diversity in the corrosive powers of different waters; in some places the use of leaden pumps has been in part discontinued, from the expense entailed upon the proprietors by the perpetual want of repair; (*c*) and if any acidity be communicated to the water, from the accidental intrusion of decayed leaves or other vegetable matter, its power of dissolving this metal will be increased to a very dangerous extent. The noted colic of Amsterdam is said by *Tronchin*, who has written a history of the epidemic, to have been occasioned by leaves falling and putrefying in

(*a*) De Architectura, lib. viii, c. 7.

(*b*) Researches into the Properties of Spring water, with Medical cautions against the use of Lead, by *W. Lambe*, M.D. &c.

(*c*) A case is recorded, wherein a legal controversy took place, in order to settle the disputes between the proprietors of an estate and a plumber, originating from a similar cause—the plumber being accused of having furnished a faulty reservoir; whereas the case was proved to be owing to the chemical action of the water on the lead. *Dr. Lambe* states an instance where the proprietor of a well, ordered his plumber to make the lead of a pump of double the thickness of the metal usually employed for pumps, to save the charge of repairs; because he had observed that the water was so hard, as he called it, that it corroded the lead very soon.

leaden cisterns, filled with rain water. *Van Swieten* (*a*) has also related an instance of a whole family who were afflicted with colic from a similar cause; and *Dr. Lambe* (*b*) entertains no doubt but that the very striking case recorded in the Medical Commentaries, (*c*) proceeded more from some foulness in the cistern than from the solvent power of the water; in this instance, the officers of a packet vessel used water out of a leaden cistern; the men also drank the same water, except that the latter had been kept in wood; the consequence was, that all the officers were seized with colic, while the men remained healthy. *Sir George Baker* has furnished the following striking illustration of the subject. "The most remarkable case that now occurs to my memory, is that of *Lord Ashburnham's* family, in Sussex; to which, spring water was supplied from a considerable distance in leaden pipes. In consequence, his lordship's servants were every year tormented with colic, and some of them died. An eminent physician of Battle, who corresponded with me on the subject, sent up some gallons of that water, which were analysed by *Dr. Higgins*, who reported that the water had contained more than the common quantity of carbonic acid; and that he found in it lead in solution, which he attributed to the carbonic acid. In consequence of this representation, *Lord Ashburnham* substituted wooden for leaden pipes; and from that time his family have experienced no particular complaints in their bowels."

But the most extensive and dangerous source of poisoning by lead, is the presence of this metal in various wines, and acescent drinks, and meats, and

(*a*) *Van Swieten* ad *Boerhaave* Aphorism. 1060 Comment.
(*b*) Libro supra citato, p. 24.
(*c*) *Duncan's* Med. Comment. Dec. 2, 1794.

which may arise either from accident or design. A knowledge of the different avenues, through which this poison may gain admittance into the human body, is therefore of great importance to the forensic physician, and we shall accordingly proceed to the investigation of the subject.

That certain wines were occasionally liable to produce endemic colics, is a fact which has been long known; although the disease was universally ascribed to a mistaken origin, until the publication of the elaborate researches (*a*) of *Sir George Baker*, into the cause of the Devonshire colic; which, like the same disease observed in other countries, was attributed to the acidity of the liquor so abundantly drunk (*b*) in these districts. This celebrated physician, however, was early led to entertain doubts with respect to the truth of this doctrine: "when I consider," says he, "that this colic of Devonshire is precisely the same disease as that which is the specific effect of all saturnine preparations, and that there is not the least analogy between the juice of apples and the poison of lead, it seems to me very improbable that two causes, bearing so little relation to one another, should make such similar impressions on the human body." The investigation of the subject completely

(*a*) See the papers by Sir George *Baker*, in the first volume of the Medical Transactions of the College of Physicians, viz. "*An Inquiry concerning the Cause of the Endemial Colic of Devonshire*," p. 175.

"*An Examination of several means by which the* POISON OF LEAD *may be supposed frequently to gain admittance into the human body, unobserved, and unsuspected*," p. 257.

"*An attempt towards an historical account of that species of Spasmodic Colic, distinguished by the name of the Colic of* POITOU," p. 139.

(*b*) See a work by Dr. *William Musgrave*, which contains the earliest account of the Devonshire colic, entitled "*Dissertatio de Arthritide symptomatica*," 1703; and also Dr. *Huxham's* work on the "*Morbus Colicus Damnoniorum*."

established the justness of these views; and no doubt remains, but that the endemic colic, which harrassed the cyder drinkers in Devonshire for some years, was the effect of saturnine impregnation, derived from the lead used in the construction of the apple mills and cyder presses; and in some cases, from the pernicious practice of introducing a leaden weight into the cask, or even racking the cyder into leaden cisterns, where the liquor fretted too much, and was thereby in danger of becoming acetous. *Sir G. Baker* also states that the custom of boiling the *must* in vessels capped with lead, affords another source of saturnine impregnation; and he informs us that, a few years ago, this very practice produced the *Devonshire colic* in the county of Kent. Some cyder, which had been made in a gentleman's family, being thought too sour, was boiled with honey in a brewing vessel, capped with lead. All, who drank this liquor, were seized with this disease; some more, others less violently; one of the servants died very soon in convulsions: several others were cruelly tortured a long time. The master of the family, notwithstanding all the assistance which art could give him, never recovered his health; but died miserably, after having for nearly three years languished under a tedious and incurable malady. *Dr. Lambe* observes, that the saturnine colic is not endemial in Devonshire, or the other cyder countries, during the whole year, but is confined to those months when the liquor is still new, crude, and the fermentation incomplete. When the liquor becomes fine, the noxious matter in a great measure separates, and is carried to the bottom of the vessel, as the feculencies subside. Tartar is generated during the vinous fermentation, the acid of which, uniting with the lead, forms a salt, scarcely, if

at all, soluble in water; and hence the purification which the liquor receives. But although this new salt is insoluble in water, it is otherwise in regard to vinegar; for this acid dissolves a small quantity, and forms a triple compound, an *aceto-tartrate of lead;* (*a*) and since no cyder, or perhaps wine, is wholly destitute of vinegar, it necessarily follows that if the liquor has been once contaminated during the first stages of fermentation, it is impossible for it ever to become entirely pure, except by processes which would render it unfit for drinking. (*b*) It has very lately been discovered, that *Gallic acid* and *tannin* are capable of combining with lead in solution, and of forming a perfectly insoluble substance, which falls to the bottom of the cask; hence all liquors which have been kept in oak casks, for a certain time, must be freed from lead. This explains a fact with respect to the effect of new rum in the West Indies, of some importance. This spirit, when newly distilled, is found to contain traces of lead, derived from the leaden rims of the coppers, and the leaden worm, used for its condensation; but, by keeping about twelve months in oaken casks, it loses its deleterious properties, and no longer exhibits any traces of this metal. (*c*)

Another source, from which acescent liquids may contract saturnine impregnation, is afforded by the metallic glazing of earthenware (*d*); that for instance

(*a*) Annales de Chimie, vol. 1, p. 76.

(*b*) See *Fourcroy*, Memoire sur la nature du Vin lithargyré, in the "Histoire de l'Academie Royale," for 1817.

(*c*) Sir *George Baker* considered that the dry belly ache, which is common to the drinkers of *new* rum, in the West Indies, ought to be wholly referred to its contamination with lead.

(*d*) The art of glazing earthenware with lead is of modern invention; that part of the old earthenware, preserved in the British museum,

of the common *cream coloured* ware is composed of an oxide of lead, (*a*) and is accordingly easily acted upon by vinegar, and saline compounds; jars and pots of this description ought therefore never to be used for preserving pickles, jellies of fruits, marmalade, and similar conserves. For the same reason, *Sir George Baker* protests against the custom of baking fruit tarts in such ware. (*b*) *Stone ware* is glazed with muriate of soda, and is therefore not liable to such an objection. (*c*)

which is supposed to have been of Roman manufacture, is not glazed. The vessels, which are called Etruscan, and which are supposed to be of greater antiquity than the Roman, have indeed a paint or polish on their surfaces; but that does not appear to resemble our modern saturnine vitrification.

(*a*) The workmen who are employed at the glazing tub are subject to colics and paralysis.

(*b*) The frequency with which the inhabitants of Madrid, and of a great part of New Castille in Spain, were harrassed with colic, as recorded by *M. Thierry*, received a satisfactory explanation from the fact of glazed earthenware having been universally used in that country for culinary vessels.

Sir G. Baker in a paper entitled "*Further Observations on the Poisons of Lead*," Med. Trans. vol. 2, p. 419, mentions the practice of drinking cyder out of glazed earthen vessels as dangerous. Dr. *Watson*, junior, saw several instances of the Devonshire colic, during the time of harvest, apparently from this cause. And a similar instance fell under the notice of Dr. *Charleston*, where six persons became, at one time, paralytic, by drinking cyder, brought to them while at harvest work, in a new earthen pitcher, the inside of which was glazed. That the glazing was dissolved by the liquor appeared not only by the effects which it produced, but from its having given, as these persons informed Dr. *Charleston*, that astringent sweetish taste to the liquor, by which the solutions of this metal are so peculiarly distinguished.

(*c*) As it is very desirable to exclude the use of *lead* altogether, the Society for the promotion of Arts, Manufactures, and Commerce, has offered a premium for a substitute for this metallic glaze. For an account of several new glazes, as substitutes for *lead*, see *Parkes's Chemical Essays*, vol. iii, p. 193—576.

The custom which prevails in some parts of England of keeping milk in leaden vessels, is extremely improper; *Dr. Darwin* (*a*) has illustrated this subject by the following case; "A delicate young girl, the daughter of a dairy farmer, who kept his milk in leaden cisterns, used to wipe off the cream from the edges of the lead, and frequently, as she was fond of cream, licked it from her finger. She was seized with the saturnine colic, and semi-paralytic wrists, and sunk from general debility." We are informed by *Mr. Parkes*, (*b*) that in Lancashire the dairies are furnished with milk-pans made of lead; and that when he expostulated with some individuals on the danger of this practice, he was told that *leaden* milk pans throw up the cream much better than vessels of any other kind.

There is, says *Dr. Darwin*, a bad custom in almost all families, and public houses, of washing out their wine bottles by putting a handful of shot corns into them, and by shaking them about forcibly to detach the super-tartrate of potass from their sides; that such a practice may occasionally give origin to serious consequences, will become evident by the relation of the following case. (*c*) "A gentleman who had never in his life experienced a day's illness, and who was constantly in the habit of drinking half a bottle of Madeira after his dinner, was taken ill three hours after dinner with a serious pain in the stomach and violent colic, which gradually yielded within twelve hours to the remedies prescribed by his medical attendant. The day following he drank the remainder of the same bottle of wine which was left the pre-

(*a*) *Darwin's* Zoonomia, vol. 3, cl. 1, 2, 4, 8.
(*b*) Chemical Essays, vol. v, p. 193.
(*c*) Philosophical Magazine, 1819, no. 257, p. 229.

ceding day, and within two hours afterwards he was again seized with the most violent pains, head-ache, shiverings, and great pain over the whole body. His apothecary becoming suspicious that the wine he had drunk might be the cause of the disease, ordered the bottle, from which it had been decanted, to be brought to him, with a view that he might examine the dregs, if any were left. The bottle happening to slip out of the hand of the servant, disclosed a row of shot, wedged forcibly into the angular bent-up circumference of it. On examining the beads of shot, they crumbled into dust, the outer crust (defended by a coat of black lead with which the shot is glazed) being alone left unacted on, whilst the remainder of the metal was dissolved. The wine, therefore, had become contaminated with *lead*, and perhaps *arsenic*, for in order to form shot the former metal is alloyed with the latter. (*a*)

But we have, hitherto, only directed the reader's attention to the different sources from which wine, and acescent liquors, may *accidentally* derive saturnine impregnation. We have now to state that such liquors have, in different ages and countries, been fraudulently adulterated with lead. It appears to have been early discovered, that wines which have become morbidly acescent may be corrected by the addition of lead; whence, in those countries where Rhenish, Moselle, and other similar wines are drunk, the saturnine colic has been endemic. The celebrated colic which raged in the province of *Poitou*, towards the end of the sixteenth, and in the beginning of the seventeenth century, was evidently the effect of such

(*a*) The use of the arsenic is to render the lead more brittle, and to dispose it to run into spherical drops.

adulteration. (*a*) We find that, in the year 1487, there was a *Recessus Imperii* promulgated at Rotenberg; and, in the year 1498, at Friberg; which was enacted, in the year 1500, at Tubingen; and, in the year 1508, at Frankfort; and, in the year 1577, in the same place. By which decrees it was made a capital crime to adulterate wines with *litharge*, or to use *bismuth* in the fumigation of them; it having been, at several periods, represented to the Emperors, that great mischief had accrued from such adulterations; and that they had been the cause of insuperable and mortal diseases. It should seem, that these laws were not carried into strict execution; and, indeed, that in the latter end of the seventeenth century, it was hardly known in Germany that such laws existed. In consequence of which, an epidemic colic arose, which was at length traced to the effects of lead in the wines. (*b*) A representation of this fact having been made to the *Duke of Wirtemberg*, it was ordained a capital crime to mix litharge with

(*a*) *Francis Citois*, the historian of this celebrated epidemic, published his "*Diatriba de novo et popular apud Pictones, dolore colico bilioso*," A. D. 1617. In which he states that the "*dolor colicus Pictonicus*" was a new epidemic in the province of Poitou, about the year 1572; and after having prevailed in that province about 60 or 70 years, it became milder, less untractable, and by degrees was translated to other parts of France. The supposition, however, says Sir *George Baker*, that the colic of Poitou was a new disease, about the time when Citois lived, is not true; the disease was even mentioned by our countryman *John of Gaddesden*, who appears to have written his *Rosa Anglica* early in the fourteenth century. If we consult authors posterior to *Citois*, we find this species of colic mentioned in almost every practical book. We have an account in *Sennertus* of its having prevailed epidemically, all over Silesia, in the year 1621." *Baglivi* even affirms that "nihil facilius colicæ supervenit, quam paralysis. None of these authors, however, appear to have entertained the slightest suspicion of the true source of the malady.

(*b*) Ephemerides Germanicæ, Ann. 4.—Observ. 60 by *Cockelius*.—Obs. 92 by *Brunnerus*.—Obs. 100 by *Wicarius*.

wine, or even to sell it in the shops, by a decree, bearing date March 10, 1696. But, notwithstanding the severity of this law, we are informed by *Zeller*, that in the year 1705, the same dangerous experiments were repeated in the circle of *Zwaabe*, with a view to correct the acidity of the weaker wines. *Bishop Watson* (*a*) informs us that, in the year 1750, the *Farmers general* in France being astonished at the great quantities *de vin gaté* which were brought into Paris, in order to be made into vinegar, redoubled their researches to find out the cause of the great increase in that article; for nearly thirty thousand hogsheads had been annually brought in for a few years preceding the year 1750, whereas the quantity annually brought in forty years before, did not exceed 1200 hogsheads. They discovered that several wine merchants, assuming the name of vinegar merchants, bought these sour wines, and afterwards, by means of litharge, rendered them portable, and sold them as genuine wines. (*b*) *Dr. Warren* (*c*) has related the cases of thirty-two persons in the *Duke of Newcastle's* family, who were residing in Hanover in June, 1752, and were seized with the *Colica Pictonum*, after having used, as their common drink, a small white wine that has been adulterated with lead. Nor has the English vintner been less regardless of the health of his employer. In a popular work on wine making by *Graham*, (*d*) which has gone through six editions, and may therefore be supposed to have done

(*a*) Chemical Essays, vol. 3, page 369, edit. 3.

(*b*) Exam. Chy. de Differ. Subs. par M. Sage, p. 157.

(*c*) Medical Transactions of the College of Physicians, vol. ii, p. 86.

(*d*) The art of making wines, from fruits, flowers, and herbs; all the native growth of Great Britain, by *William Graham*, late of Ware in Hertfordshire.

some mischief, we find under the article of *vintner's secrets*, the following receipts.—

"*To hinder wine from turning*,

"Put a pound of melted lead, in fair water, into a cask, pretty warm, and stop it close."

"*To soften green wine*,

"Put in a little vinegar, wherein litharge has been well steeped, and boil some honey to draw out the wax. Strain it through a cloth, and put a quart of it into a tierce: and this will mend it, in summer especially."

We have already alluded to the presence of lead (*a*) in the *new* rum of the West Indies, as the cause of the disease known in that country by the name of the *dry belly-ache*; it remains for us to state that the excise officers frequently avail themselves of the peculiar power of the *sub-acetate of lead* to precipitate colouring matter, in order to remove from seized Holland gin, the colour which it obtains by being long kept in the tubs in which it is smuggled over. A practice which it is said renders the gin liable to gripe.

According to the important experiments of *Proust*, (*b*) it appears, that if lead be associated with tin, it will be incapable of furnishing to acids any saturnine impregnation. The following are the interesting conclusions at which this philosopher has arrived, viz.

"That the *tinning*, which contains even so large a proportion as an equal part of lead, cannot be dangerous; since it is sufficient that the lead should be

(*a*) See "*Some experiments made upon Rum, in order to ascertain the cause of the colic, frequent among the Soldiers in the island of Jamaica, in the years* 1781, *and* 1782; by JOHN HUNTER, M.D. In the Medical Transactions, vol. 3, p. 227.

(*b*) Annales de Chimie, tom. lvii, p. 84. Memoire de *M. Proust*.

combined with tin, in order to prevent it from being dissolved, either in lemon juice, or vinegar, the two acids most to be feared. The tin, being more oxidable than the lead, dissolves exclusively in these acids, and prevents the second from being attacked. *The lead cannot appropriate to itself an atom of oxygen, but the tin would carry it off in an instant.*"

SUGAR OF LEAD—*Saccharum Saturni—Cerussa Acetata—Plumbi Super-acetas.*

This salt of lead, to whose presence, the numerous accidental maladies above enumerated are to be chiefly attributed, occurs in commerce in the form of irregular masses resembling lumps of sugar, being an aggregation of acicular four-sided prisms terminated by dihedral summits; its taste is sweet and astringent. It is soluble in 25 parts of water, hot, or cold; when common spring water, however, is employed for such a purpose, a white precipitate occurs from the presence of a certain proportion of *sulphates* and *carbonates*.

When this salt is exposed to the action of heat, it undergoes aqueous fusion, then dries, and at length is decomposed, leaving a globule of metallic lead, mixed with the yellow protoxide, and an acid product of a fetid smell. This decomposition is similar to that which vegetable substances undergo when heated for some time. The quantity of metallic lead, thus obtained, will be more considerable if the salt has been previously mixed with charcoal, and particularly if it be submitted for a long time to the action of a powerful heat. The strong sulphuric acid of commerce, when poured upon *sugar of lead* in powder, decomposes it with effervescence, and disengages vapours of acetic acid.

This must be considered as an active preparation, and may, when administered in doses of a few drachms, speedily occasion death. At the same time, like other poisons, it may by judicious administration, become a valuable remedy. See *Pharmacologia*, art. *Plumbi Super-acetas.*

In consequence of the sweet taste of this salt, children have been induced to swallow it.

Goulard's Extract. *Liquor Plumbi Sub-acetatis.*

This liquor is a saturated solution of the *sub-acetate of lead.* Spring water, from the salts which it contains, produces with it a very milky and turbid appearance; and even when *distilled*, in consequence of the carbonic acid diffused through it, it will occasion precipitation. It is principally used as an external application to diminish inflammation, an effect which it probably produces by paralysing the nerves of the part. Cases have occurred where this lotion has been accidentally swallowed, and the usual symptoms of saturnine poisoning have supervened. How far its external application may be capable of occasioning mischief, will form a subject of inquiry under the consideration of the physiological action of the preparations of lead.

White Lead. *Sub-Carbonate of Lead. Cerusse.*

The substance, known in commercial language by the name of *White Lead*, has received at different times, very various appellations, in consequence of the fluctuating opinions which have prevailed respecting its composition. Thus it has been successively styled a *sub-acetate*, an *oxide*, and a *sub-carbonate;*

of which the last is unquestionably the correct name. In the large way it is prepared by exposing sheets of metallic lead to the fumes of vinegar. The sub-carbonate so produced appears as a white, brittle, and scaly substance, on the surface of the lead; which is scraped off, and afterwards ground in mills fitted for the purpose. Formerly, it was ground dry, and the workmen suffered severely from the operation; it is now ground in water, and the sub-carbonate is afterwards dried in earthen pans placed in stoves, heated by means of flues; still, however, persons employed in grinding white lead, as well as painters (*a*) who are constantly using it, occasionally suffer severely, from the want of cleanliness in not washing their hands before eating, by which some of the white lead is introduced into the stomach with their food.

Litharge. *Semi-vitrified Oxide of Lead.*

This is a yellow protoxide of lead, which has been melted, and left to crystallize by cooling. It is in the form of small reddish, or yellowish scales, which are brilliant and vitrified. Its character is so peculiar that it cannot easily be mistaken. It is employed for various purposes in the arts, and is the saturnine preparation more usually selected for the purpose of removing acidity from wines, as above related.

When treated with a muriatic salt, and submitted to a high temperature, a *muriate of lead* is produced, of a bright yellow colour, the brilliancy of which may be much heightened by grinding it as usual with oil. In this state it forms the pigment known by the name

(*a*) *Cerusse* was in great request among the Roman ladies as a cosmetic.

of *Turner's yellow*, or *patent yellow*. (*a*) It is very poisonous.

Red Lead. *Minium.*

This red oxide of lead is easily distinguished by its colour, weight, and the facility with which it yields metallic lead, when heated with carbonaceous matter. Common red wafers, which derive their colour from this oxide, afford a striking illustration of this fact, for if burnt in a candle, globules of metallic lead will be observed to flow from them. It is poisonous; and we have already alluded to a case where Gloucester cheese (*b*) occasioned deleterious effects, in consequence of its adulteration with *red lead*. (p. 277) It is destructive also to inferior animals, apparently in very small quantities; red wafers prove poisonous to birds who may pick them up; and the same paste is sold for the purpose of destroying beetles, in which it succeeds very effectually. Since it is employed as a pigment, it may on many occasions prove an accidental cause of poisoning; there is indeed one very common and dangerous source, mentioned by *Sir George Baker*, (*c*) which deserves to be particularized in this place, viz. the practice of painting toys with *red lead*, and other poisonous substances; children, observes this distinguished physician, are apt to carry every object which gives them delight to their mouths, the painting of toys, therefore, with poisonous co-

(*a*) The manufacture of this colour was long kept secret; but its consumption has lately been greatly lessened by the introduction of the artificial Chromate of Lead, which is a yellow of much greater brilliancy than the muriate of that metal.

(*b*) See Repository of Arts, vol. viii, no. 47, p. 262.

(*c*) Med. Trans. vol. 2, p. 445.

lours, is a practice which ought to be abolished, and is the more open to censure, as it is of no real utility.

Symptoms of poisoning by the different preparations of Lead.

The effects of this poison will vary considerably according to the quantity swallowed, and the circumstances under which it is taken. We shall, therefore, first consider its operation, in doses sufficiently large to occasion at once violent effects; and then describe its agency as an *accumulative* poison, where it is introduced into the system gradually, and in small quantities, so as to act slowly and imperceptibly, and to lay the foundation of irreparable mischief, before any alarm is occasioned.

1. *Symptoms which follow a large dose.* Where a salt of lead has been taken in a considerable dose, the patient soon experiences excruciating pains in the abdomen, accompanied with sickness and vomiting; the colic increases to a violent degree, but admits of temporary alleviation by pressure, a circumstance which at once distinguishes it from the effects of corrosive poison. Although it is necessary to observe, that inflammatory symptoms may afterwards occur, where the dose has been very considerable, and the consequences direct and speedy.

The patient describes the pain as if produced by a boring instrument, and the abdominal muscles become knotted, and sometimes painfully retracted with all the contents of the abdomen towards the spine. (*a*) The sphincter muscles of the bladder and anus are

(*a*) See a paper in the Medical Transactions, vol. 2, p. 68, "Of the Colica Pictonum, by *R. Warren*, M.D. &c.

always affected; sometimes strangury and tenesmus are the consequences; at other times, a total incapacity of making any water at all, and so great a contraction of the sphincter ani that a clyster can hardly be introduced. After suffering these torments for a period of an indefinite duration, delirium and cold sweats may supervene, and the patient die in convulsions. If, however, the treatment has been prompt and judicious, and the quantity of poison has not been excessive, he may recover from its immediate effects, and live to testify the severity of the consecutive phenomena. A most inveterate constipation of the bowels will continue for a considerable period, and there will be an occasional recurrence of colic; at length a peculiar species of palsy will supervene in the upper extremities, especially affecting the muscles of the fore arm, and wrist. (*a*) *Citois* has given us a striking description of this stage of the saturnine disease. "*Per vicos, veluti larvæ, aut arte progredientes statuæ, pallidi, squalidi, macilenti conspiciuntur, manibus incurvis et suo pondere pendulis, nec nisi arte ad os et cæteras supernas partes sublatis, ac pedibus non suis, sed crurum muculis, ad ridiculum, ni miserandum, incessum compositis, voce clangosa et strepera.*" It does not appear that the train of symptoms above described has ever been excited by any other external cause than the one here assigned. Whenever we meet with colic, attended with paralytic symptoms of the extremities, we may at once conclude that it has arisen from the influence of lead.

The disease has been described by authors under

(*a*) *Paulus Ægineta* is the first writer who has described a species of Colic terminating in Paralysis. (Lib. iii, c. 18, 43.)

the name of the *colic of Poitou*, (*a*) or *colica Pictonum*, (*b*) from the circumstance of its having raged with such epidemic fury in that province, in consequence of the adulteration of its wines with lead. It is also mentioned as the painter's colic, since this class of artists is very commonly visited by the disease, in consequence of the *white lead* contained in their pigments. At the Lead Hills, it is known to the miners, under the provincial name of *milreek;* and in Derbyshire, under that of *belland.* (*c*)

2. *Symptoms arising from the introduction of lead into the system, by small and repeated doses.*

The effects produced upon various artists by the imperceptible operation of lead, sufficiently shew the power which this metal possesses of accumulating in the human system, and it is probable, says *Sir George Baker*, that from an observation of such slow, but certain effects of lead, the French and Italians derived the hint of preparing their celebrated poisons, called "*Poudres de Succession;*" (*d*) the basis of which has been supposed to have been some preparation of that mineral. *Zeller* mentions a certain chemical operator, near the confines of Bohemia, who, after having diligently applied himself to the composition of poisons, did, by means of lead, combined with some more volatile and corrosive substance, prepare a most slow poison, which given to dogs and

(*a*) Poitou, this late province in France was divided at the revolution into the three departments of Vendée, Vienne, and the Two Sevres.

(*b*) Pictones—*Cæs.* People of France, whose chief city is Pictavium, now called Poictiers.

(*c*) *Percival's* Essays, vol. 1, p. 458.

(*d*) See our remarks upon this subject at page 142. See also *Teichmeyer*, Inst. Med. For. p. 164.

other animals, had the power of destroying them, without producing any violent symptoms, after several weeks, or even months. (*a*)

The following curious case, (*b*) communicated by *Dr. Wall*, of Worcester to *Sir George Baker*, will serve to illustrate the present subject, and to shew that lead may gain admittance into the human body, unobserved, and even unsuspected. "A gentleman of Worcester was the father of a numerous offspring, having had one and twenty children, of whom eight died young, and thirteen survived their parents. During their infancy, and indeed until they had quitted the place of their usual residence, they were all remarkably unhealthy; being particularly subject to disorders of the stomach and bowels. The father, during many years, was paralytic; the mother, for as long a time, subject to colics and bilious obstructions. She died at last of an obstinate jaundice. This disease had been several times removed by the use of the Bath water; but it always came on again soon after her return to Worcester; and at last eluded every method and medicine which was tried. After the death of these parents, the family sold the house which they had so long inhabited. The purchaser found it necessary to repair the pump. This was made of lead; and, upon examination, was found to be so corroded, that several perforations were observed in the cylinder, in which the bucket plays; and the cistern in the upper part was reduced to the thinness of common brown paper, and was full of holes like a sieve. The waters of this town are re-

(*a*) Upon the subject of slow poisons we have already expressed the latitude of our belief, see page 143.

(*b*) Medical Transactions, vol. 2, p. 420.

markably hard. It is then more than probable that the water of this pump, thus impregnated with lead, occasioned the unhealthiness of the family who drank it. I have been just informed by the plumber," adds *Dr. Wall*, "that he had several times repaired the pump in question; and that he had done so not more than three or four years before the gentleman's death; when he found it nearly in the same state as it has been described; so that the corrosion was effected in a short time; and consequently the water must have been very strongly impregnated with the noxious quality of the metal."

Organic lesions discovered on dissection.

The reports of the dissection of those who have been destroyed by saturnine poisons are far from being satisfactory. Where the person has died from the primary effects of a large dose of the acetate of lead, the stomach has betrayed a state of inflammation, similar to that which results from the action of a corrosive poison; black points and spots, from venous extravasation, have been also observed in the interior of this viscus; *M. Orfila* states that he has seen in the stomach of animals who have taken a large dose of the acetate of lead, and have not vomited, a membraneous lining tolerably thick, of an ash colour, easily detaching in small pieces; the origin of which appeared to be owing to the decomposition of a part of the acetate of lead by the mucous, bilious, and other fluids, contained in this viscus. The mucous membrane lying under this lining, was of a dark grey colour throughout its whole thickness, and appeared to have exercised the same action on the acetate of lead. The case is very different in those who have

died from the slow action of this metal; all anatomists agree in reporting, that in the *colica pictonum*, the digestive canal exhibits no vestige of inflammation; (*a*) but the diameter of the large intestines, especially that of the colon, is generally contracted; thus displaying the effects of that operation, which is supposed to be characteristic of the compounds of lead, and which has bestowed upon them the peculiar designation of *astringent* poisons. *Foderé* states that the mesentery and its glands; and the lacteal and lymphatic vessels, are inflamed and obstructed, and the thoracic duct almost obliterated; the liver, spleen, pancreas, and lungs often inflamed, tumefied and purulent, and even the heart shrivelled; (*b*) and the whole body, in consequence of the constriction of the chyliferous vessels, in a state of complete marasmus. Upon this passage *Orfila* makes the following observation. "We are under the necessity of declaring, that almost all these signs are wanting in the majority of the cases of simple colic of lead, terminated by death." *Fourcroy*, in a note to his translation of *Ramazzini*, "*De Morbis Artificum*," observes that the intestines have, in these cases, been discovered distended by air, parched, and slightly altered in colour; and that in the larger ones, balls of dry, dark coloured, excrementitious matter, have been found.

Physiological action of Lead Poisons.

The preparations of lead seem to act upon the nervous system, destroying its energy, and thereby producing paralysis. Whether this is effected through

(*a*) Transactions of Medical Society of London.

(*b*) Med. Legale, iv, § 921.

the medium of the circulation, or whether they produce their effects without being absorbed, appears to us to be a question which has not hitherto received a satisfactory answer. It must, however, be admitted that they act upon the alimentary canal, by coming into contact with its nerves; and in some cases, where the dose of the *acetate* has been large, it may have produced death by the local injury which it inflicted. *Dr. Lambe* observes upon this subject, that "certain facts render it probable that lead does not operate entirely through the medium of the circulation, nor by nervous sympathy; but also topically, affecting the part to which it is applied more than the other parts of the body." This latter position is clearly established by the beneficial effects occasioned by the topical application of lead to inflamed surfaces; nor can any doubt exist as to the fact of such applications having produced local paralysis. There is a paper in the third volume of the *Medical Transactions* by *Dr. Reynolds*, in which the case of a gentleman is detailed, who brought on a temporary paralysis of the *sphincter ani*, by freely using *Goulard's* lotion for the cure of piles. Foreign writers have also maintained that saturnine applications have frequently occasioned impotence; for further information upon this subject the reader may refer to *Istitutione di Medicina Forens: di Tortosa, vol.* 1, *p.* 58; also *Fritze Compend: sopra i Malat. Vener. p.* 189; and *Monteggia Annotat. sopra i Mali Venerei, p.* 36. *Sir George Baker* states that he has some reason to doubt, whether *litharge*, the common basis of our plasters, when used for the purpose of dressing issues, has not, in certain irritable constitutions, produced some of the ordinary effects of saturnine preparations taken internally. There have been instances of children

thrown into convulsions, by *cerusse*, sprinkled on excoriated parts. *Zeller* quotes, on the authority of *Molingius*, a remarkable instance of the pernicious effects of *litharge*, externally applied. (*a*) *Sir George Baker* met with a most violent and obstinate colic, which seemed to have been occasioned by some litharge, mixed in a cataplasm, and applied to the *vagina*, with a view to allay a troublesome itching; and he says that he was informed by *Dr. Petit* that *Goulard's poultice* applied for some time to a patient's knee, in St. George's hospital, occasioned violent pain in the bowels, which did not cease until the poultice had been removed; nor are authorities deficient to prove, that the fashionable application of *cerusse* to the skin has been followed by obstinate colics, pains, and tremors. We have been desirous of laying before our readers the above authorities, in proof of the constitutional effects which may be occasionally produced by the external application of lead, since the fact has been questioned, and is still considered by many as involved in doubt and uncertainty. *Dr. Lambe* is inclined to believe, that "to the production of the saturnine colic, it is necessary that the metal should be applied *immediately* to the stomach and intestines." If this hypothesis be just, he excludes nervous sympathy, as well as absorption, as a proximate cause of saturnine colic; and, consequently, no dependence can be placed on the accounts given by the above pathologists with regard to the produc-

(*a*) "De Lithargyrio quoque mihi narravit, matronam quandam nobilem pulverem ejus in rubore faciei, postquam hic ipsi tanquam singulare et certissimum arcanum deprædicatus fuisset, in petia ligatum, axillis bis vel ter die aspersisse cum præsentaneo effectu; verum exinde subsecuta fuisse dyspnæam, lipothymiam, dolores vagos in abdomine, vomiturition em, et nauseam."

tion of such an effect by lotions and cataplasms of lead.

Of the chemical processes, by which the presence of lead may be detected.

These will necessarily vary according to the different states of combination in which it may be supposed to exist; we shall, therefore, proceed to consider the modes of establishing its presence, 1, In solution in *water; wine; spirit;* and *oils.* 2. In a state of mixture with *various solids.* 3. Combined with *solid or liquid aliments.*

1. *The lead exists in some unknown state of combination in solution in water.* We are greatly indebted to *Dr. Lambe* (*a*) for the able directions which he has afforded us for ascertaining the presence of minute portions of lead in water; and we recommend the practitioner, who may be engaged in such an investigation, to peruse his work with attention. The following are the reagents through which our analysis must be conducted.

(*a*) *Sulphuretted hydrogen.* A solution of this gas in distilled water is a very delicate test for lead, throwing down a precipitate of a very dark brown colour, approaching to black. The competency, however, of this test to the discovery of very minute quantities of lead, in certain states of combination, has been questioned by *Dr. Lambe;* who was enabled to detect the presence of this metal, by other methods, in water that manifested no indication with *sulphuretted hydrogen.* He detected it, for instance, in the precipitate occasioned in such water by the

(*a*) See his "Researches into the Properties of Spring water." 8vo. London. *Johnson.* 1803.

carbonate of potass or soda. In operating on these waters, he noticed the following appearances.

1. *The precipitate, produced as above stated, when re-dissolved in nitric acid, formed a dark cloud with sulphuretted hydrogen.*
2. *Although the sulphuretted hydrogen formed no cloud, the precipitate itself became darkened by it.*
3. *The precipitate re-dissolved in nitric acid,* (as in 1) *formed, with sulphuretted hydrogen, a white cloud.*
4. *Sulphuretted hydrogen neither formed a cloud, nor darkened the precipitate.*
5. *In the cases* 2, 3, 4, *if the precipitate be heated to redness, in contact with an alkaline carbonate; and after dissolving out the carbonate, it be re-dissolved in nitric acid; then sulphuretted hydrogen will form a dark cloud with the solution.* In these experiments it is necessary that the acid used to redissolve the precipitate be not in excess; if it should so happen, the excess must be saturated, before the test is applied. It is better to use so little, that some precipitate may remain undissolved. The nitric acid, used in these experiments, should be perfectly pure; and the sulphuretted hydrogen test should be recently prepared by saturating distilled water with the gas.

(*b*) *Sulphate of soda, or potass.* This test will produce a white precipitate in water, containing one hundred-thousandth of its weight of lead; and is considered by *Dr. Thomson* as the most unequivocal re-

agent of that metal which we possess. "The precipitate is a fine dense powder, which speedily falls to the bottom, and is not re-dissolved by nitric acid; no other precipitate can be confounded with it, except *sulphate of baryta*, and there is no chance of the presence of baryta in solution in water." (*a*)

(*c*) *Muriate of soda.* One of the methods of analysis proposed by *Dr. Lambe*, consists in precipitating the lead by common salt; but as the *muriate of lead* is partly soluble in water, this test cannot be applied to small portions of suspected water. The precipitate must, therefore, be collected from two or three gallons, and heated to redness with twice its weight of carbonate of soda. The alkaline carbonate is then to be dissolved out, and nitric acid added, in order to saturate any superfluity; the *sulphuretted hydrogen* test will then produce its indication.

(*d*) *Reduction of the metal.* This is undoubtedly the most satisfactory of all the tests; and, except the trouble of collecting a large quantity of precipitate, is not embarrassed with any difficulty. The precipitate may be mixed with its own weight of alkaline carbonate, and exposed either with, or without, the addition of a small proportion of charcoal, to a heat sufficient to melt the alkali. On breaking the crucible, a small globule of lead will be found reduced at the bottom. The precipitate from about fifty gallons of water yielded *Dr. Lambe* about two grains of lead.

2. *The lead is dissolved in wine.* For the detection of this dangerous fraud, the reagent invented by *Dr. Hahnemann* affords a ready and convenient test. It consists of water saturated with sulphuretted hydro-

(*a*) Observations on the Water with which Tunbridge is supplied for domestic purposes.

gen gas, and acidulated with muriatic acid; (*a*) this latter ingredient is added for the purpose of preventing the precipitation of any iron, which the wine might accidentally contain. This liquor will, if added in the proportion of one part to two of wine, produce with the smallest quantity of lead, a dark coloured, or black precipitate; which, if collected, dried, and fused before the blow-pipe on a piece of charcoal, will yield a globule of metallic lead. Or we may modify the experiment by passing a current of sulphuretted hydrogen gas through the wine, having previously acidulated it with muriatic acid, to prevent the precipitation of the iron.

A farther proof of the presence of lead in wines is the occurrence of a precipitate, on adding a solution of the sulphate of soda.

The most satisfactory proof, however, is derived by distilling off the alcohol, and calcining the residuum with charcoal, in order to obtain the metallic lead.

The quantity of lead which has been detected in sophisticated wine, may be estimated at forty grains of the metal in every fifty gallons, (*b*) but this will of course be liable to vary with the degree of acidity it was intended to correct.

3. *The lead is dissolved in oils.* In this case the lead may be detected by shaking, in a stopped phial, one part of the suspected oil, with two or three parts

(*a*) The following is the method of preparing the test. Expose equal parts of sulphur and powdered oyster shells to a white heat for fifteen minutes; and, when cold, add an equal quantity of cream of tartar; these are to be put into a strong bottle with common water to boil for an hour; and the solution is afterwards to be decanted into ounce phials, adding twenty drops of muriatic acid to each.

(*b*) *Lambe*, op. sup. cit. page 175.

of water, impregnated with *sulphuretted hydrogen*. This test will announce the presence of the deleterious metal, by occasioning a dark brown, or black colour.

4. *The lead is mixed with alimentary matter.* *M. Orfila* has furnished us with the following directions for assaying the matter vomited, or that which may be found in the digestive canal, after death. "After having expressed the fluid portion through a piece of fine linen, it must be assayed by the *tests*, which have been already enumerated as being capable of detecting the salts of lead; and if the precipitates obtained are of a nature to induce a belief, that the fluid contains some preparation of this kind, it must be evaporated to dryness, and calcined with charcoal in a crucible; when, at the expiration of three quarters of an hour, metallic lead will be obtained. If all the experiments made on the fluid portion of the matter vomited, for the discovery of this poison, should be fruitless, the whole of the solid portions, previously dried, should then be calcined with potass and charcoal, by which means metallic lead will be obtained."

VEGETABLE POISONS.

The poisons of which we are about to offer the physiological and chemical history, although more numerous than those which belong to the mineral kingdom, are, notwithstanding, of far less importance in a forensic point of view. With the exception of opium, and some few others, they must be considered as objects of accidental, rather than of criminal poisoning; and even with respect to the former narcotic, it may be said to afford more frequently the means of destruction to the suicide, than to the assassin.

The sensible qualities of smell, taste, and sometimes colour, which so eminently characterise deleterious plants, must necessarily render them ill calculated to favour that secresy, which constitutes the indispensable companion of crime; while their bulk, and the pharmaceutical preparation which they require, are alike inconsistent with the hope of concealment.

Thus we receive, as it were, from Nature, that protection which art can no longer supply; and the commission of crime is either prevented or discovered, in cases where the powers of chemistry would fail in its detection.

The objects which constitute the vegetable kingdom differ from every species of mineral matter, not only in their peculiar organized structure, but in the chemical arrangement of their elements; those of inorganic matter are generally combined in very simple pro-

portions, as one and one, or one and two, &c. whereas in organized bodies, their proportions are much more complicated; and *Dr. Ure* observes, (*a*) that such substances derive the peculiar delicacy of their chemical equilibrium, and the consequent facility with which it may be subverted and new modelled, to the multitude of atoms grouped together in a compound; hence too, as *Mr. Children* (*b*) has observed, is one reason of our utter inability to reproduce even the simplest body of this class, when once its elements have been separated; it is not in the diversity of these elements, but in the manner in which they are grouped, that this peculiarity consists, for, continues the accomplished chemist last mentioned, "vegetable substances seldom contain, as essential, more than three principles—*oxygen*, *hydrogen*, and *carbon*, and sometimes *azote*. With four simple elements then, a brief alphabet for so comprehensive a history! has a bountiful Omnipotence composed the beautiful volume of the living world, where, turn to what page we may, fresh loveliness meets the eye, fresh cause of admiration and delight."

The analysis of vegetable bodies resolves itself into two parts, each of which constitutes an equal object of interest to the forensic physician; who, it will be shewn, may occasionally derive important information from both. The first relates to the discovery of the *proximate* principles of a vegetable substance. The second, to that of its *ultimate* elements. By the *proximate*, or, as they are sometimes termed, the *immediate* principles, we mean those compound substances which exist in the living plant in a state identical

(*a*) On the ultimate Analysis of Vegetable and Animal Substances, by *Andrew Ure*, M.D.F.R.S. Phil. Trans. for 1822, part. 2.

(*b*) Essay on Chemical Analysis, by *J. G. Children*, *Esq.*

with that, under which chemical processes exhibit them, and are chiefly separable by the action of different solvents. The number of these principles is considerable, as *gum*, *starch*, *sugar*, *gluten*, *extractiue*, *tannin*, *oils*, *acid*, *&c. &c.* By the *ultimate* elements, we understand those, of which the *proximate* are composed, as *oxygen*, *hydrogen*, *carbon*, and *azote*. In submitting a plant to destructive analysis, for the purpose of obtaining its ultimate elements, we shall derive compounds, which formed no part of the vegetable structure, and which result from a new arrangement of the elements composing it; *acetic* and *carbonic acids*, for example, are obtained by the destructive distillation of several vegetable substances, in which neither of these acids existed ready formed, but only their elements. (*a*) It may easily be imagined to what numerous fallacies such a law of composition must have given origin, in the earlier periods of chemical inquiry; and it is equally evident, that the utmost refinement of chemical science, and the most rigorous methods of analysis, will be required to enable us to deduce any satisfactory conclusion with respect to the quality of a plant, from these data. Such perfection, indeed, has not hitherto been attained, but the period is probably not far distant, when our most sanguine anticipations upon this point may be realised. We have only to trace the history of this branch of chemistry for the last century, to become satisfied of its gradual and important progress towards such an epoch, and of the improvements of which this department of vegetable analysis is farther susceptible; let us, for the sake of illustra-

(*a*) Where a compound is merely separated it is called an EDUCT; but where it arises from a new combination of the elements it is distinguished by the term PRODUCT.

tion, only compare the rude results obtained by the academicians of Paris, at about the commencement of the seventeenth century, with those of *MM. Gay-Lussac* and *Thenard* (*a*), or with those, very lately instituted in this country by *Dr. Ure*, (*b*) and we shall perceive that while the former of these experimentalists, by the aid of heat, were unable to form the slightest distinction between the most inert, and the most poisonous species of plants, the latter, by means of the same agent, aided by the modern doctrine of equivalent ratios, has succeeded in establishing the proportions in which the elements of each vegetable body combines; and with such accuracy, as to discriminate between substances, which bear the greatest analogy to each other; as between the varieties of sugar, and those of oil; and even between common flax, and the same substance prepared according to the improved process of *Mr. Lee*. This statement is sufficient to show the capability of ultimate analysis, on certain occasions, to identify vegetable bodies; but we are, at present, scarcely advanced far enough in such an investigation, to make it subservient to the detection of vegetable poisons. Nor has our knowledge with regard to proximate analysis, been less successfully advanced. The late researches of the French and German chemists have demonstrated the existence of several new alkaline bodies in the class of vegetable poisons, to which some of these plants appear to be exclusively indebted for their activity, as the *poppy*, *hellebore*, *colchicum*, *&c*; and whose characters are so distinct and striking, as to enable the chemist to recognise

(*a*) Recherches Physico-Chimiques.

(*b*) On the ultimate Analysis of Vegetable and Animal Substances, by *Andrew Ure*, M.D.F.R.S. Phil. Trans, for 1822, part 2.

their presence by appropriate re-agents. In other cases, the virulence of a plant would appear to depend upon the combination of several (*a*) proximate principles; while in some few instances there exist in the same individual vegetable, two distinct elements of activity, as illustrated by the interesting history of tobacco.

In cases of vegetable poisoning it will occasionally occur, that some remains of the plant may be collected; and seeds, portions of the fungi, and leaves, may be found in the contents of the stomach; whence a knowledge of botany becomes indispensable. This branch of science is, moreover, important to the toxicologist, as enabling him to pursue the study of plants with greater precision; for experience has shewn that there is a wonderful analogy between the structure of those plants which resemble each other in medicinal operation. Thus those which, from their dismal and dusky appearance, have been arranged under the title of *Luridæ*, are in general highly poisonous; they also possess a very peculiar and disagreeable smell, so that Nature has, upon this occasion, kindly given us notice of approaching danger, by means of our senses.

Of equal importance with the knowledge of the generic and specific characters, is that of their sensible qualities, and the changes which these latter undergo by pharmaceutical preparation.

(*a*) The author has already in the fifth edition of his Pharmacologia, entered so fully into the philosophy of medicinal combination, that he can scarcely feel regret at the limits of the present work not allowing him to dwell upon the subject.

Cl. III. ACRID, or RUBEFACIENT POISONS.

Most of the subjects of this class constitute articles of Materia Medica; so that ignorance on the one hand, and accident on the other, may render them the unexpected source of mischief. With respect to the physiological action of these bodies, the reader has only to refer to our classification at page 207, to perceive that it will not admit of generalization; for each division, it will be observed, contains individuals which belong to the class of acrid poisons.

As the history of most of these articles is to be found in works on Materia Medica, we shall not enter so fully into their properties, as we might otherwise have considered necessary.

Camboge or Gamboge.

This beautiful gum-resin is obtained by making incisions in the leaves and young sprouts of the *Stalagmitis Cambogioides* (*a*) (Polygamia Monæcia—*Nat. ord.* Tricoccæ. *Wild*:) It is first collected, in the kingdoms of Siam and Ceylon, in cocoa-nut shells, and is thence transferred into large earthen jars, where it remains until it is nearly dried to a cake, when it is formed into rolls, and wrapped up in leaves. It is imported into Europe (*b*) in cases and boxes. Its deep yellow colour, which is so materially brightened by being wetted, and its shining fracture, are characters sufficiently striking to

(*a*) The Cambogia *Gutta* Lin. (Polyandria Monogynia) and several species of Hypericum; Chelidonium, &c. also yield a similar juice.

(*b*) The Dutch appear to have first introduced it into Europe about the middle of the seventeenth century.

enable the practitioner to identify it; and when we add to these the history of its habitudes with different menstrua, the chemist will have no difficulty in detecting its presence, viz. when triturated with water, two-thirds of its substance are speedily dissolved, and a turbid solution results; alcohol dissolves nine-tenths, and forms a yellow transparent tincture, which is rendered turbid by the addition of water; sulphuric ether dissolves six-tenths of the substance; it is also soluble in alkaline solutions, and the resulting compound is not rendered turbid by water, but is instantly decomposed by acids, and the precipitate so produced is of an extremely brilliant yellow colour, and soluble in an excess of acid.

Its action upon the animal œconomy is that of a powerfully drastic purge. We are, however, not acquainted with any case in which death followed its administration. From the experiments made upon animals, it would appear to produce its effects by a local action on the textures, with which it comes in contact, and it will accordingly be found in the third class of our physiological classification, (page 207.)

White Hellebore. (*a*)

Veratrum Album. (Polygamia—Monæcia—*Nat. Ord.* Coronariæ. *Linn.*—Junci. *Juss.*)

This is undoubtedly the true hellebore of the ancients. It is a native of the mountainous parts of Greece, Italy, Switzerland, and Russia. Those specimens which are cultivated in our gardens flower in July. The root is the only part employed in medicine, but every part of the plant is extremely acrid and poisonous. Upon the animal œconomy it acts as

(*a*) Ελλεβορος λευκος of Dioscorides.

a violent cathartic and emetic; producing bloody stools, excessive vomitings, great anxiety, vertigo, tremors, sinking of the pulse, syncope, cold sweats, convulsions, and death. There are many cases on record, where such effects have followed the ingestion of this plant. *Helmont* reports that a royal prince died in the course of three hours after taking a scruple of this poison, which induced convulsions; and *Vicat* (*a*) relates the case of a tailor, his wife, children, and workmen, who having taken soup, in which, through mistake, the root of white hellebore had been introduced instead of pepper, were seized with a universal coldness, and such extreme debility, as to become nearly insensible. At the expiration of two hours, the eldest child, who was not four years of age, began to vomit copiously, but with considerable straining; the rest were shortly after in the same condition. *Vicat*, who was called in at this critical period, ordered them to take a considerable quantity of warm water and oil; shortly after which he administered an infusion of mallow sweetened with honey; by which means, we are informed, they were relieved, and ultimately restored. According to the testimony of various physiologists, as well as from the experiments of *Orfila*, it appears that this plant, if externally applied, will produce the same effects. *Etmuller* says, that the external application of the root to the abdomen will produce vomiting; and *Schroeder* observed the same phenomenon to take place in a case where it was used as a suppository; the juice of the plant has been also applied to the purpose of poisoning arrows. It must, therefore, act by being absorbed into the circulating current, thereby destroying the energ

(*a*) Histoire des Plantes Vénéneuses de la Suisse.

of the nervous system. It accordingly finds a place in the second division of our classification. Late experiments upon this substance have shewn that its activity depends upon a peculiar alkaline principle, to which the name of *veratria* (*a*) has been given; and that it exists in native combination with an excess of gallic acid, *(super-gallate of veratria)*.

When taken internally, as a poison, the most effectual antidote is said to be a very strong infusion of nut-galls.

Black Hellebore. *Melampodium.*

Christmas-rose. (Polyandria Polygynia. *Nat. Ord.* Multisiliquæ, *Linn.* Ranunculaceæ, *Juss.)*

This plant, which has derived its name from the dark colour of the root, is a native of Austria, the Apennines, and Italy; it has, however, obtained a place in our gardens, (*b*) and from the circumstance of its flowering from December till March, it has acquired the name of the christmas rose. The fibres of the roots are the parts employed in medicine; their odour is fœtid, and their taste bitter and acrid. Its action upon the animal œconomy is similar to that of the preceding species. *Morgagni* relates the history of a person who took half a drachm of black hellebore, and expired eight hours afterwards. *M. Orfila* states that inflammation of the rectum is a constant occurrence, where the animals who have taken this root, have survived its administration for a few hours.

(*a*) The same alkali has been discovered in the seeds of the *Veratrum Sabadilla*, and in the root of the *Colchicum Autumnale*.

(*b*) It was first cultivated by *Gerarde* in 1596.

FŒTID HELLEBORE. *Helleborus Fœtidus. Helleboraster.*

This plant is a native of England, growing in shady places, on a chalky soil, and flowering in March and April. Like the former species of hellebore, it is capable of producing fatal effects. A case is related in the *London Chronicle*, 1768, no. 1760, of a child who died in consequence of taking the root of this plant in the pulp of an apple.

ELATERIUM. *Wild*, or *squirting Cucumber.* *Momordica Elaterium* (Monæcia Monadelphia. *Nat. Ord.* Cucurbitaceæ.)

This plant is a perennial native of the south of Europe, flowering in June and July; it is cultivated in England, but does not survive the severity of our winters. The fruit *(poma)* has the appearance of a small oval cucumber, of a greyish colour, and covered with prickles. When fully ripe it quits the peduncal, and casts out the seed and juice, with great force, and to a considerable distance, through the hole in the base where the foot-stalk is inserted, whence the name of *squirting* cucumber. The author has instituted numerous experiments upon this plant, the results of which will be found fully detailed, under its history, in the fifth edition of his Pharmacologia.

The plant appears, from the testimony of *Dioscorides*, and other writers, to have been employed by the ancient physicians with much confidence and success as a cathartic; all the parts of the plant were considered as purgative, although not in an equal degree; thus *Geoffroy*, "*radicum vis cathartica major*

est quam foliorum, minor vero quam fructuum." This question, however, has been very lately set at rest, by the valuable experiments of *Dr. Clutterbuck*, (*a*) which prove that the active principle of this plant resides more particularly in the juice which is lodged in the centre of the fruit. The forensic physician, however, will scarcely be liable to meet with a case of poisoning by the fruit of this plant. It is from that preparation of the juice, which is admitted into our Pharmacopœia, under the title of *Extract of Elaterium*, that we may expect to meet with mischief.

This substance subsides spontaneously from the juice of the fruit; and occurs in commerce in little thin cakes, or broken pieces, bearing the impression of the muslin upon which it is dried; its colour is greenish, its taste bitter, and somewhat acrid; and when tolerably pure it is light, pulverulent, and inflammable. Notwithstanding its extreme activity, it does not, according to our experiments, (*b*) contain more than a tenth part of active matter, which is a vegetable proximate principle, *sui generis*, and to which we have given the name of ELATIN. By treating the Elaterium with alcohol, this principle may be obtained; it imparts to the spirit a most brilliant, and beautiful grass green colour—but see our experiments upon this subject. The action of elaterium is that of a most violent drastic cathartic, especially affecting the rectum. It destroys life by its local action, and consequently finds a place in the third division of our classification.

(*a*) See London Medical Repository, vol. xii, no. 67.
(*b*) Pharmacologia, vol. ii, art. *Extract. Elaterii*, p. 204.

COLOCYNTH. *Coloquintida; Bitter Apple.*

This is the fruit of the *Cucumis Colocynthis* (Monœcia Monodelphia, *Nat. Ord.* Cucurbitaceæ) an annual of Turkey and Nubia. It is of the size of an orange, of a yellowish-white colour, devoid of smell, round, dry, light, spongy, and smooth on the outside, when ripe; it is trilocular, each cell containing many ovate, compressed, whitish seeds, enveloped by a white spongy pulp. It is imported into this country, after having been peeled, and dried in a stove. Its taste is extremely bitter and acrimonious. It acts upon the human body as a powerfully drastic purgative. *Fordyce*, (*a*) relates the case of a woman who was subject to colics for the space of thirty years, in consequence of having taken an infusion of this fruit in beer. *Tulpius* (*b*) has also furnished us with an account of the tremendous effects produced by an overdose of the same article; and *Orfila* has shewn, with his usual accuracy, that it acts not only locally upon the *primæ viæ*, but by being absorbed, and carried into the circulation.

EUPHORBIUM. *Euphorbia Officinarum* (Dodecandria Trigynia. *Nat. Ord.* Tricoccæ Lin. Euphorbiæ *Juss.*)

This gum resin is imported from Barbary, in drops, or irregular tears; its fracture is vitreous; it is inodorous, but yields a very acrid, burning impression on the tongue. Its acrid constituent resides exclusively in that portion which is soluble in alcohol. This poison has been sometimes administered impru-

(*a*) Fragmenta Chirurg. et Med. p. 66.
(*b*) Obs. Lib. iv, c. xxvi, p. 208.

dently as a purgative when it has produced vomiting, and bloody stools. *Lamotte* speaks of a clyster prepared with it, which proved fatal. It acts as a caustic upon the textures with which it comes in contact, and thus destroys life by a local action; indeed its nature is so acrid that when applied to the hair, or to warts, it causes them to fall off. *Scopoli* mentions the case of a person who, having the eye-lids closed, allowed them to be rubbed with the juice of this plant; in consequence of which inflammation followed, and the sight was lost. In pulverizing the gum-resin, the parmaceutist should take the precaution of previously moistening it with vinegar, or the powder will rise, excoriate his face, and excite violent inflammation of the eyes. There are many species (*a*) of *Euphorbium*, or *spurge*, which are highly poisonous; and, being indigenous, they have frequently proved the cause of mischief; during the last summer the author was consulted on the occasion of a family of children having been seized with a violent inflammation of the eyes, and eruption on the face, when the phenomenon was very satisfactorily traced to the action of the *Euphorbia peplus*, which was growing very luxuriantly in the garden where the children had been playing.

Savine.

Juniperus Sabina. (Diæcia Monadelphia—*Nat. Ord.* Coniferæ.)

This shrub is a native of the south of Europe and the Levant; but has been long cultivated in our gar-

(*a*) The juice of every species of *spurge* is so acrid, that it corrodes and ulcerates the body wherever it is applied. Warts or corns, annointed with the juice presently disappear; hence this tribe of plants has derived the popular name of *wart weed*.

dens. The leaves and tops of the plant have a strong, heavy, disagreeable odour, and a bitter, hot taste, with a considerable degree of pungency; qualities which depend upon the presence of an essential oil. Upon the animal system it acts as a very powerful stimulant, and has been received into the list of the materia medica, as an active emmenagogue; while it has long enjoyed, amongst the vulgar, the reputation of being capable of producing abortion. (*a*) Upon this point we have only to observe, that it does not exert any specific action on the uterus; but as a violent medicine, acting upon the general system, it might, in common with other stimulants, produce so much disturbance as to be followed by abortion. The experiments of *Orfila* have shewn that savine exerts a local action, but that its effects depend principally on its absorption, through which medium it acts on the nervous system, the rectum, and the stomach.

Aconite. *Monkshood.*

Aconitum Napellus (Polyandria Trigynia—*Nat. Ord.* Multisiliquæ, *Linn.* Ranunculaceæ, *Juss.*)

There are several species of aconite, all of which are poisonous. The *monkshood* is a well known plant, met with in our gardens, and when swallowed in any quantity will produce the symptoms, characteristic of vegetable poisons. All the parts of aconite, in the fresh state, when chewed, produce a sense of heat, and shortly afterwards a sensation of numbness in the lips and gums, which does not subside for several hours.

(*a*) One of the supposed proofs of the guilt of *Charles Angus* in the case of *Margaret Burns*, as stated at page 177, rested upon the fact, that on searching the prisoner's bed room, three bottles were found in the wardrobe, viz. one marked "*poison water;*" a second "*Jacob's water;*" and a third "*Savine oil.*"

In ancient authors, we frequently meet with *aconite* as a poison, but it has been fairly questioned whether any particular plant was designated by the term (*a*); like that of *cicuta*, it seems to have been a word expressive of poisons generally. The most powerful form in which this vegetable poison exists is in that of extract, or inspissated juice (*b*), and, if prepared according to the improved process of *Mr. Barry*, (*c*) it will prove highly dangerous in small doses. *M. Orfila* relates several fatal accidents from the ingestion of this plant; his experiments have also shewn that it will produce its effects by an external application. We agree, however, with *Mr. Brodie* in considering that it acts, without being absorbed, on the brain, through the medium of the nerves; and we have accordingly placed it in the first division of our classification.

The plants already enumerated are sufficient to illustrate the symptoms and physiological action of the acrid poisons of the vegetable kingdom. We shall, therefore, conclude the history of this class with some account of the *nitrate of potass*, which has been ranked both by *Fodéré* and *Orfila* under this division of their classification.

(*a*) The roman poets constantly use it in the plural number, which evidently shews that it was meant to denote other kinds of poisons, or poisons in general; thus JUVENAL in the first satire, v. 156.

"Qui dedit ergo tribus patruis ACONITA, vehetur
Pensilibus plumis,——"

So again *Ovid* in the first book of Metamorph, v. 47.

"Lurida terribiles miscent ACONITA novercæ."

(*b*) *Theophrastus* tells us that a poison may be prepared from *aconite* so as to occasion death within any definite period; see page 183 in the present volume.

(*c*) See an account of this process of preparing extracts *in vacuo*, in Medico-Chirurg. Trans. vol. x, p. 240; and for a history of their superior powers, the author begs to refer the reader to an account of the articles in his Pharmacologia.

Nitre. *Nitrate of Potass.*

The sensible qualities of this salt are too well known to require any description. It generally occurs crystallized in six-sided prisms, terminated by dihedral summits. It is composed of one proportional of nitric acid, and one proportional of potass. It dissolves in seven parts of water at 60°, and in its own weight at 212° *Fah.* Its solution is attended with a great reduction of temperature. It is permanent in the air, melts when exposed to a moderate heat; and, when cast into moulds, constitutes what is known in commerce by the name of *sal prunelle.* When mixed with inflammable matter it undergoes, in a strong heat, a rapid species of combustion, which, in chemical language, is termed *deflagration.* Concentrated sulphuric acid, when poured upon this salt in powder, decomposes it at the ordinary temperature, and disengages vapours of nitric acid, which are white, and not very abundant.

Symptoms of poisoning by Nitre.

This salt, when taken in a large dose, acts violently on the stomach and bowels, and occasions syncope and death. There are several cases recorded of its having been taken by mistake for *Glauber's salt.*

On these occasions, the patients have been seized with violent vomiting and purging of blood, attended with severe pains in the bowels, and a sense of burning heat, referred to the chest and stomach; cold extremities, fluttering pulse, laborious breathing, syncope, and death. The above effects have been produced by an ounce and a half of nitre; although, as

Dr. Gordon Smith has observed, the same quantity of this salt has been inadvertently swallowed *without* the production of such tremendous consequences.

From the experiments of *Orfila*, it appears that if this salt be inserted into a wound, it occasions a fatal gangrene. Its action is undoubtedly the effect of its acrid nature, destroying the vitality of the textures with which it comes in contact. It is not absorbed.

Organic lesions discovered by dissection.

In those recorded cases of death from the ingestion of nitre, the stomach has been found red, scattered over with blackish spots, and its mucous membrane disorganized.

Chemical processes for the detection of Nitre.

The property which this salt possesses of deflagrating with combustible bodies, affords a ready indication of its presence. The process also, which we have described under the history of nitric acid, (p. 312) as the one suggested by *Dr. Wollaston*, and adopted by *Dr. Marcet* in his examination of sea water, furnishes an elegant mode of ascertaining the presence of a nitric salt.

Cl. IV. NARCOTIC POISONS.

These constitute a class of vegetable poisons, less extensive, perhaps, but of far greater importance and interest, than the one we have already considered. It would not be easy to enumerate the various purposes to which the active imagination of man has applied the tribe of narcotic plants. Medicines, poi-

sons, intoxication, and madness, lie concealed beneath their juices. They have, in their turn, arrested the pangs of disease, and inflicted death upon the unsuspecting object of hatred and revenge; they have animated the courage of the warrior, inspired the enthusiasm of the poet, soothed the sorrows of the wretched, and furnished the debauchee with a daily source of sensual gratification; effects which, although apparently incompatible with each other, may be commanded by the same substance, in a different dose. It would be foreign to the plan of this work to enter into a physiological inquiry into the *modus operandi* of these extraordinary agents; and the author relinquishes the labour with less regret, as he has already, in another work, (*a*) very fully considered the several theories which have been advanced for its explanation.

Opium, and its Preparations.

This well known drug is the inspissated juice of the *Papaver Somniferum* (Polyandria Monogynia. *Nat. Ord.* Rhoedææ, *Linn.* Papaveraceæ *Juss.*) obtained by making incisions in the half ripe capsules, at sun-set, when the night dews favour the exudation of the juice, which is collected in the morning by old women and children, who scrape it from off the wounds with a small iron scoop, and deposit the whole in an earthen pot, where it is worked by wooden spatulas in the sun-shine, until it attain a considerable degree of spissitude. It is then formed by the hand into cakes, which are laid in earthen basins to be further exsiccated. (*b*) Two kinds are found in commerce, distinguished by the names of *Turkey*, and *East In-*

(*a*) Pharmacologia, vol. I, p. 136.
(*b*) Med. Observ. and Inquiries, vol. v. p. 317.

dian opium. The latter kind is regarded as being inferior to the former.

Turkey opium occurs in flat pieces, of a solid compact texture, possessing considerable tenacity; its specific gravity is 1·336, so that, when compared with concrete juices of other plants, it is heavy, being exceeded only in this respect by opoponax and gum arabic. It is of a reddish-brown, or fawn-colour, and has a peculiar, heavy, and narcotic odour; its taste is acrid, bitter, and hot. By long exposure to the air, it becomes hard, and breaks with a glimmering fracture, owing to the presence of a few saline particles. It is plastic, and when worked with the fingers is adherent to them. When brought near a lighted candle it inflames, and burns with a brilliant light, but its odour at that time is not narcotic. It is partially soluble in water, alcohol, æther, wine, vinegar, and lemon-juice. When triturated with hot water, five parts in twelve are dissolved, six suspended, and one part remains perfectly insoluble, and resembles the gluten of wheat, but is of a dark colour. The alcoholic is more highly charged with its narcotic principle than the aqueous solution; but spirit, rather below proof, is its best menstruum.

Few vegetable substances have been more frequently, or more ably submitted to analysis; and the history of the successive steps by which our knowledge respecting its composition has advanced, must encourage us in hoping that we shall shortly be enabled to identify, by chemical tests, the presence of opium, with as little difficulty and as great precision as we are already capable of recognising a metallic poison.

According to the latest chemical views respecting the composition of this body, it may be stated to con-

sist of the following principles, viz. resin, gum, bitter extractive, sulphate of lime, gluten, and the three lately discovered bodies, *narcotine*, *morphia*, and *meconic acid*.

In the year 1803, *Derosne* first obtained from opium a crystalline substance, which he found to dissolve in acids, but he does not appear to have instituted many experiments, for the elucidation of its nature and properties. In 1804 *Seguin* discovered another crystalline body, and although he described many of its properties, what appears very extraordinary, he never even hinted at its alkaline nature. *Sertuerner*, at Eimbeck in Hanover, had at the same time as *Derosne* and *Seguin*, obtained these crystalline bodies, but it was not until the year 1817, that he first proclaimed the existence of a vegetable alkali, and attributed to it the narcotic powers which distinguish the operation of opium; to this body, he gave the name of *Morphia*, and it would appear to be the same as the essential salt of *Seguin*. The salt of *Derosne* was also at first mistaken for the same principle, but the experiments of *Robiquet* have pointed out its distinctive properties, and it has received the name of *Narcotine*.

Morphia, upon which the soporific powers of opium depend, appears to exist in native combination with a peculiar acid, to which the name of *meconic* acid has been bestowed. The following are the essential characters of this alkaline body, when procured in a state of purity. (*a*)

It crystallizes in fine, transparent, truncated pyramids, the bases of which are either squares or rec-

(*a*) It may be obtained from opium by the following process, invented by Robiquet. Three hundred parts of pure opium are to be

tangles, occasionally united base to base, and thereby forming octohedra. It is sparingly soluble in boiling water, but dissolves abundantly in heated alcohol, giving rise to an intensely bitter solution; in æther it is far less soluble. It has also the characters of an alkali; affecting test papers tinged with tumeric or violets, uniting with acids and forming neutral salts, and decomposing the compounds of acids with metallic oxides. It unites with sulphur by means of heat, but the combination is no sooner formed than it is decomposed. It fuses at a moderate temperature, when it resembles melted sulphur, and like that substance crystallizes on cooling; it is decomposed by distillation, yielding carbonate of ammonia, oil, and a black resinous residue, with a peculiar smell; when heated in contact with air, it inflames rapidly, and like vegetable matter, it leaves a carbonaceous residue. When analyzed by means of the deutoxide of copper, it yields carbon, hydrogen, and oxygen, the atomic proportions of which have not yet been ascertained. The nitric acid of commerce, when dropped on *morphia*, communicates to it a beautiful red colour. *Ser-*

macerated during five days, in one thousand parts of common water; to the filtered solution, fifteen parts of perfectly pure magnesia (carefully avoiding the *carbonate*) are to be added; boil this mixture (A) for ten minutes, and separate the sediment (B) by a filter, washing it with cold water until the water passes off clear; after which, treat it alternately with hot and cold alcohol (12, 22. Bé) as long as the menstruum takes up any colouring matter; the residue is then to be treated with boiling alcohol (22, 32, Bé) on cooling, the solution will deposit the *Morphia* in crystals.

Rationale of the process. A soluble *meconiate of magnesia* is, in the first place, formed; (A) while the sediment (B) consists of *morphia*, in the state of mixture, with the excess of magnesia; the boiling alcohol, with which this residuum is treated, exerts no action upon the magnesia, but dissolves the *morphia*, and, on cooling, surrenders it in a crystalline state.

tuerner has given us an account of the effect of the alcoholic solution of *morphia* on himself, and three of his pupils; he found that repeated small doses of half a grain produced at first decided excitation; then weakness, numbness, and tendency to fainting; after swallowing vinegar while in this condition, violent vomiting was excited; in one delicate individual, profound sleep intervened, and on the following day he suffered from nausea, vomiting, head-ache, anorexia, constipation, and heaviness. (*a*) This case is sufficient to shew, that although *morphia* possesses the characteristic powers of opium, its strength is by no means commensurate with its supposed state of concentration. When uncombined, it exerts little or no action, in consequence of its insolubility in water, and in the fluids of the stomach. When, however, it is combined with an acid, particularly the acetic, or the *meconic*, with the latter of which we have before stated that it exists in opium, it displays its properties in a very eminent degree. It is also very soluble in oil; and, according to the experiments of *M. Majendie*, the compound acts with great intensity.

The *meconic acid*, when separated from the residuum of the magnesian salt, as described in the process for the preparation of morphia (*note p.* 386) does not appear to possess any medicinal activity. Its distinguishing *chemical* character is, that it produces an intensely red colour in solutions of iron, oxidized *ad maximum;* and a deep blue, with solutions of the salts of gold. *Narcotine* is the salt originally obtained by *Derosne*, and is supposed by *MM. Majendie* and *Robiquet* to be the peculiar principle which produces the excitement experienced by those who

(*a*) Ann. de Chim. et de Phys. tom. v.

take small doses of opium. It may be entirely removed by macerating the extract of opium in sulphuric æther.

Symptoms of poisoning by Opium.

In considerable doses, the primary action of this substance, as a powerful and diffusible stimulant, is not apparent; for the powers of life are immediately depressed, drowsiness and stupor succeed, and these are followed by delirium, stertorous breathing, cold sweats, convulsions, and apoplectic death.

The quantity of opium necessary for the production of such effects must be regarded as *relative*. In no two cases can we ensure a similar result, by the administration of the same dose. But, of all the circumstances capable of modifying the power of this drug, habit is the most remarkable; in illustration of which we have only to adduce the history of the opium eater, or laudanum drinker; a species of debauchee by no means uncommon, as every London chemist can testify, for he frequently experiences considerable doubt and difficulty in distinguishing persons, to whom habit has rendered large doses of opium necessary, from such as purchase it with a view to suicide. (*a*) The lowest fatal dose, to those unaccustomed to it, seems to be about four grains; but the Turk will take three drachms in the morning, and repeat the same dose at night, without any other effects than that of cheerfulness and exhilaration. This temporary impunity, however, is dearly purchased by years of suffering and sorrow. The effects of opium, says *Russel*, on those who have been addicted to it, are at

(*a*) "Confessions of an English opium-eater." London, 1822.

first obstinate costiveness, succeeded by diarrhœa and flatulence, with loss of appetite, and a sottish appearance; their memories soon fail, they become prematurely old, and then sink into the grave objects of scorn and pity. (*a*)

Where a person has, from accident, or design, swallowed a large dose of pure opium, or laudanum, the symptoms produced are so characteristic and striking, that the practitioner, who may be summoned to render assistance, will have no difficulty in ascertaining their cause.

Insensibility, with a scarcely perceptible respiration, although in some cases it is attended with an apopletic stertor; the countenance is livid and cadaverous; the skin cold; and the muscles of the limbs and trunk in a state of extreme relaxation. The pupils are insensible to the impression of light, and the pulse is almost imperceptible. In some stages, the patient, by being strongly shaken, may be roused for a few moments from the lethargy; there is generally a narcotic odour distinguishable in the breath. Vomiting may also take place upon the first impression of the laudanum upon the stomach; although after its action has been displayed upon the brain, it will be difficult to excite emesis by the most powerful means; the reason of which may be very satisfactorily deduced from the ingenious experiments of *M. Majendie* on the mechanism of vomiting; by which he proves, that without the influence of the brain, the muscles, whose actions constitute an essential part of the operation, are incapable of performing their duty, and that vomiting therefore cannot take place. This is a very important doctrine, inasmuch as it suggests

(*a*) History of Aleppo.

to the pathologist several expedients, by which he may be enabled to occasion vomiting, by recalling the excitability of the brain. The period which will elapse, between the ingestion of the poison, and the death of the sufferer, may be stated to be from six to twenty-four hours; but it will in each case be liable to vary, not only from the quantity of opium swallowed, but from the habit and peculiar circumstances of the individual submitted to its operation.

Physiological action of Opium.

It is still a question for the decision of future physiologists, whether the narcotic principle of opium destroys the functions of the nervous system by a local impression upon the stomach, (*a*) or by being absorbed, (*b*) and brought into contact with the brain in the course of the circulation. We are inclined to adopt this latter opinion, and have therefore placed *opium* in the second division of our classification; at the same time, we think that it may occasionally produce an effect upon the nervous extremities of the stomach, and we have accordingly placed an *asterisk* against the word, by which we denote this double mode of operation. But, by whatever medium it may act, it is evident that it occasions death by destroying the functions of the brain; in consequence of which the muscles of respiration, no longer sup-

(*a*) *Orfila* states that animals, on which the section of the *par vagum* of both sides has been performed, die at the end of two or three hours; after having experienced intoxication, somnolency, and convulsions. *Bulletin de la Soc. Philomatique, Mai* 1808, *i.* 1, *p.* 143.

(*b*) *Tortosa (Istituzioni di Med. For.)* has remarked that opium may act mortally without losing much of its weight in the stomach. We are very sceptical upon this point.

plied with nervous energy, cease to contract, and the animal dies in a state of suffocation. (*a*)

Of the treatment in cases of poisoning by Opium.

The first object is the evacuation of the stomach by vomiting; for which purpose, the patient should be made to swallow from fifteen grains to a scruple of *sulphate of zinc;* or, from five to ten grains of *sulphate of copper* dissolved in water; and the vomiting should be kept up for a considerable time, and urged by irritation of the fauces. Where the act of vomiting cannot be established, in consequence of the paralysed state of the nervous system, cold affusion, applied by means of a shower bath, has been said to restore the energy of the brain, and thus to render the patient susceptible of the stimulus of an emetic. (*b*) Venesection has also, under the same circumstances, been greatly extolled; and, as vascular congestion in the brain is one of the effects of this poison, it is reasonable to conclude that, by unloading the vessels of this organ, we may restore its lost sensibility. *Tissot* has strongly recommended the practice, (*c*) and the experiments of *Orfila* have shewn that it never aggravated the symptoms of poisoning by opium, nor accelerated the moment of death; but on the con-

(*a*) The reader is requested to refer to our chapter "On the Physiological causes and phenomena of sudden death," p. 22.

(*b*) See "Cases illustrating the decided efficacy of cold affusion in the treatment of poisoning by opium, by *S. Wray.*" *London Medical and Physical Journal*, for September 1822.

"A case of poisoning by opium, in which the cold affusion was successfully employed; with observations on the medical management of similar occurrences, by *J. Copland*, M. D." *Ibid.*

"On the most efficacious means of remedying the effects of opium, when taken in poisonous doses, by *J. H. Sprague.*" *Ibid.*

(*c*) Avis au *peuple*, tom ii, § 535, p. 280, 7th edlt.

trary, that in some instances he found that it restored the animals which would have died, if it had not been put in practice. Where the operation is performed, the blood should be drawn from the jugular vein, in preference to any other. Should these means prove insufficient to provoke vomiting, *M. Orfila* asks, whether one or two grains of *tartarized antimony*, dissolved in one or two ounces of water, might not be injected into the veins? It was formerly proposed by *Boerhaave* to empty the stomach of its poisonous contents, by the introduction of a syringe; an operation which, it is said, has been lately performed with success. (*a*) Vinegar and vegetable acids were long considered as *antidotes* to opium; but the experiments of *M. Orfila* have clearly established that, as long as any portion of the opium remains in the stomach, these potations, so far from relieving, aggravate the symptoms of poisoning by this narcotic, in consequence of the power which they possess of dissolving it. Where, however, the opium has been expelled by vomiting, these acid drinks possess the property of *diminishing the consecutive symptoms*, and of thus realising the expectations which *Virgil* (*b*) has so poetically raised,

——"*quo non præsentius ullum*
Auxilium venit, ac membris agit atra venena."

The powers of the habit should, at the same time, be supported by brandy, strong coffee, and cordials. The sufferer should be kept awake; and, if possible,

(*a*) "On the common syringe, with a flexible tube, as applicable to the removal of opium, and other poisons, from the stomach, by *F. Bush.*" *London Med. and Phys. Journ.* for September, 1822.

"New means of extractiug opium, &c. from the stomach, by *E. Jukes, Esq.*" *Ibid.* for November, 1822.

(*b*) See Pharmacologia, vol. I, p. 234.

in a continued gentle motion. *Dr. Currie* (*a*) has recommended the affusion of warm water at 106°, or 108°, for removing the stupor.

A case is recorded by *Dr. Marcet*, in the first volume of the Medico-chirurgical Transactions, where six ounces of laudanum were taken by a young man, and remained for five hours in the stomach before any remedies were applied for its removal; a strong dose of sulphate of copper, however, provoked vomiting, and by judicious treatment he eventually recovered.

Organic lesions discovered on dissection.

It has been very truly remarked that although the instances in which opium has proved fatal to human life have been very numerous, yet that the accounts which we have received of the appearances of the body *post mortem*, are by no means so satisfactory as we could desire. *M. Orfila* asserts that no alteration can be discovered on dissection, in the digestive canal of persons who have swallowed any narcotic poison; and that if facts contrary to this assertion be met with in various authors, it is because there have been administered irritating substances capable of producing inflammation. (*b*) The lungs,

(*a*) Reports on Water, 1, 80.

(*b*) A very high degree of vascularity is often found in the stomach and alimentary canal of those who have been suddenly deprived of life. The reader may consult *Dr. Yelloly's* paper in the *Medico-chirurgical Transactions*, vol. iv, respecting the appearances found in the stomachs of several executed criminals.

A case of poisoning by opium is given in the foreign department of the London Medical Repository, for November 1820; in which two drachms of solid opium had been swallowed, and on dissection a general congestion of blood was found in the internal organs.

however, frequently exhibit morbid phenomena; their colour is sometimes violet, and frequently a deeper red than in the natural state. Their texture is also more dense, and less crepitating; and they are marked by livid spots. The blood contained in the ventricles of the heart, and in the veins, is said to be found in a liquid state; but *Orfila* advances a diametrically opposite opinion, and asserts that it is frequently coagulated. The brain and its membranes often exhibit a state of vascular congestion; in the case recorded by *Mr. Stanley*, in the sixth volume of the *Transactions of the College of Physicians*, the cellular tissue of the pia mater was found to contain water. (*a*)

Of the detection of Opium.

There is no mode of identifying opium, whether in a liquid or solid form, so satisfactory as that which is at once afforded by its powerful and highly characteristic odour. In fatal instances, we shall always meet with it in the contents of the alimentary canal, and in such quantities as will leave no doubt as to its nature. The chemist may also proceed to a farther examination, by obtaining *morphia* from its solution, by a process which we have already described under the chemical history of opium.

(*a*) The stomach in this case was observed to be red, but the colour was traced to the tincture of cardamoms, which the deceased had taken.

Black Henbane. *Hyoscyamus Niger.*

(Pentandria Monogynia. *Nat. Ord.* Luridæ *Linn.* Solaneæ *Juss.*)

Henbane is an indigenous annual, frequent on waste grounds, and at the sides of roads, particularly on a calcareous soil, flowering in July. The whole of the plant is poisonous when eaten; and in the recent state the odour of the leaves occasions stupor and delirium. The root of this plant when in full vegetation is very powerful; and there are several cases on record, where it has been eaten in mistake for parsnips, (*a*) which it strongly resembles in its sweet and agreeable flavour. Its operation is very analogous to that of opium; producing sickness, stupor, delirium, and coma, with dilalation of the pupils.

The pulse, at first hard, gradually becomes weak and tremulous; petechiæ frequently make their appearance, and death ensues. Late experiments have shewn that a peculiar alkaline body constitutes the active principle of this plant, and it has accordingly received, from its discoverers *MM. Meissner* and *Brandes*, the name of *Hyoscyama.*

Boerhaave experienced a trembling and drunkenness, in consequence of having prepared a plaister, into whose composition *henbane* entered as an ingredient; and the experiments of *M. Orfila* have shewn that it acts nearly in the same manner, whether applied upon the cellular texture, introduced into the stomach, or injected into the veins. Hence it follows that the active principle of this plant is carried into the circulation, and exerts a remarkable action on

(*a*) Philosophical Taansactions, vol. xl, p. 446.

the brain and nervous system, producing an extraordinary state of delirium, which is succeeded by stupefaction. The physician will never probably be called upon to investigate a case of wilful poisoning by this narcotic; and should he be summoned to attend a person who, through mistake or accident, had swallowed it, we can hardly anticipate any peculiar mystery which requires elucidation.

There are several other species of henbane, as *hyos. alb. aureus, physaloides*, all of which are poisonous, although not in the same degree as the *hyoscyamus niger*, whose history we have just considered.

Prussic Acid. *Hydro-cyanic Acid.*

The Laurel (*Prunus lauro-cerasus*) and its distilled water. Bitter Almonds, and their essential oil.

Hydro-cyanic acid exists in a great variety of native combinations in the vegetable kingdom, and imparts to them peculiar qualities, which have been long known. It is, however, only within a few years, that this singular body has been obtained in its separate and independent form (*a*); indeed it was not until the publication of the celebrated memoir of *Gay-Lussac* upon this subject, in the year 1815, that its chemical composition was fully understood. In this memoir, it was clearly shewn to consist of a peculiar, gaseous, and highly inflammable compound of carbon and nitrogen, to which the name of *cyanogene* has been assigned, and hydrogen; the latter

(*a*) It was discovered by *Scheele*, but *Gay-Lussac* first succeeded in depriving it of a very great quantity of the water with which it was combined, when prepared according to the process of its discoverer. See *Annales de Chimie*, tom. lxxvii, p. 123.

body acting as the acidifying principle; whence the term *hydro-cyanic acid* is very happily contrived to express its composition.

When obtained in its most concentrated form, by the process of *M. Gay Lussac*, (*a*) it has the following characteristic properties, viz. At ordinary temperatures, it is liquid, colourless, and transparent; possessing an extremely powerful odour, very analogous to that of the blossom of the peach, or bitter almond tree; its taste is, at first, bland and sweetish, but afterwards pungent, bitter, and peculiar. Its extreme volatility is such, that when a drop of it is exposed to the air, on the end of a glass rod, it is rapidly crystallized. The same phenomenon takes place, if a drop be suffered to fall on a sheet of paper. Its specific gravity is ·7055; but, when in a concrete form it is only ·9, while that of its vapour is ·947. If inhaled, it produces almost immediate pain in the head, with deafness, unless very largely diluted with air or water. (*b*) It is decomposed by a high temperature; and by the action even of light it is, in the course of a very short time, resolved into carbonic acid, ammonia, and carburetted hydrogen, a carbonaceous matter remaining behind. (*c*) When brought near a body in a state of combustion, it instantly inflames and burns with a blue light. In water it is sparingly soluble; alcohol dissolves it copiously.

(*a*) By the decomposition of muriatic acid, and the cyanuret of mercury.

(*b*) *Dr. Majendie* has informed us that, in consequence of some carelessness, he breathed a portion of the vapour, while preparing the acid for the purpose of experiment; and that he suffered very violent pains in the chest, accompanied by feelings of oppression, which endured for several hours.

(*c*) "En conservant cet acide dans des vases bien fermés, même sans quil ait le contact de l' air, il se decompose quelquefois en moins d' une heure." *Gay-Lussac.*

The "*medicinal Prussic acid*," as it has been called, as being the preparation lately introduced into medicine, (*a*) differs only from that we have just described, in its degree of concentration. It is, in fact, the Prussic acid of *Scheele*, and may be considered as equivalent to the preparation of *Gay-Lussac* diluted with six times its volume, or eight times and a half its weight, of distilled water.

The *hydro-cyanic acid* has been discovered, in a state of perfect formation, in a variety of vegetables, whose peculiar odour at once announces its presence; such are bitter almonds; the kernels of apricots, cherries, particularly the *Cerasa Juliana*, and several plums; the leaves of laurel; and peach blossoms; and the bark of the *prunus padus*, or bird-cherry tree. The only mineral substance, in which hydro-cyanic has yet been detected is the *Fer Azuré* of Hauy. (*b*) Animal substances, although they do not contain it ready formed, yet, when treated with an alkali at a high temperature, they yield it in great abundance, in consequence of the combination of its elements.

Action of hydro-cyanic Acid as a Poison.

The experiments which have been instituted with a view to ascertain the exact effects of this substance upon animal life, very clearly prove that the acid of *Gay-Lussac* is one of the most active poisons in nature; and that the various vegetable bodies, into whose composition it enters, exert an energy, corre-

(*a*) See "An Historical and Practical Treatise on the Internal use of hydro-cyanic (Prussic) acid, by *A. B. Granville*, M.D." Second edit. London, 1820.

(*b*) See, however, an account of "A new substance found accompanying Welsh Culm, by *J. A. Paris*, M.D." in the first volume of the Transactions of the Royal Geological Society of Cornwall.

sponding with the quantity of this constituent, and the degree of concentration, in which it exists. The experiments of *M. Orfila* were made with Prussic acid, prepared according to the process of *Scheele*, and consequently containing a great proportion of water, as we have already explained; and yet the effects which followed its administration were extremely energetic. From the *Annales de Chimie*, for October 1814, we learn that a professor of chemistry, having inadvertently left on his table a phial filled with a solution of Prussic acid in alcohol, a female servant, who had been seduced by its agreeable smell, drank a small glass-full of it, and fell dead at the end of a few minutes, as if struck by apoplexy.

The following case is quoted by *Dr. Granville*, from *Hufeland*. *D. L.* a robust and healthy man, aged 36 years, while about to be seized as a thief by the police officers, snatched a small sealed phial from his pocket, broke off the neck of it, and swallowed the greatest part of its contents. A strong smell of bitter almonds soon spread around, which almost stupefied all present. The culprit staggered a few steps; then, without a groan, fell on his knees, and sunk lifeless down to the ground. Medical assistance being called in, not the slightest trace of pulse or breathing could be found. A few minutes afterwards, a single and violent expiration occurred, which was again repeated in about two minutes. The extremities were perfectly cold, the breast and abdomen still warm, the eyes half open and shining, clear, lively, full, almost projecting, and as brilliant as those of the most ardent youth under violent emotion. The face was neither distorted nor convulsed, but bore the image of quiet sleep. The corpse exaled a strong smell of bitter almonds, and the remaining li-

quid, being analysed, was found to be a concentrated solution of Prussic acid in alcohol. Cases also stand recorded where, from imprudent exposure to the vapours of the Prussic acid, persons have exhibited all the appearances of being poisoned. Some writers assert that *Scheele* himself, who died suddenly, while engaged in some inquiries into the nature and formation of this acid, was affected by its deleterious qualities. *Orfila* relates that *Scharinger*, Professor at Vienna, prepared some pure concentrated Prussic acid, and having diffused a certain quantity of it upon his naked arm, he died a short time afterwards. The professor, however, did not die in consequence of this accident; it appears, upon inquiry, that he was seized with apoplexy while sitting in a coffee house in the evening.

The distilled water of the *cherry laurel* (*a*) has been proved, by numerous awful examples, to be a most energetic poison; and from the fatal effects to which the officinal preparation of it gave rise, it was early expunged from the Pharmacopœia of the London College. In the *Philosophical Transactions* for the year 1731, we shall find the history of its effects upon a woman of the name of *Boyce*, who, with a view to disprove an allegation, that one *Mary Whaley* had died in consequence of drinking a small quantity of laurel water, swallowed three spoonsful, and, afterwards, two more of the same liquid; after which she died in a very short time, without making the least complaint, and without any convulsion.

Foderé (*a*) informs us that during the period he was pursuing his studies at Turin in 1784, the chamber-

(*a*) The poisonous properties of this plant are alluded to by *Strabo*, who says that the *Lauro-cerasus* produces a mode of death, similar to that of epilepsy.

maid and man servant of a noble family of that town, for the purpose of regaling themselves, stole from their master a bottle of distilled laurel water; fearful of being surprised, they hastily swallowed several mouthsful of it; but they soon paid the price of their dishonesty, having almost instantly expired in convulsions. Works on Toxicology also abound with the relation of experiments, made by numerous physiologists on different animals, with this deleterious liquid. Amongst the experimentalists we may enumerate the names of *Madden*, *Mortimer*, *Browne*, *Langrish*, *Nicholls*, *Stenzelius*, *Heberden*, *Watson*, *Vater*, *Rattrai*, the *Abbé Rozier*, *Duhamel*, *Fontana*, and *Orfila*. In this country we have had several fatal cases of poisoning by laurel water. In the year 1782, *Dr. Price*, of Guildford, having professed to have converted mercury into gold, offered to repeat his experiments before a competent tribunal, but the unfortunate philosopher put a period to his existence before the day appointed for his exhibition, by a draught of laurel water; a mode of death which had been, no doubt, suggested by the celebrated trial of *Donellan*, for the murder of *Sir Theodosius Boughton*, that had taken place in the preceding year, and left a strong impression upon the public mind; and whose details, it has been justly observed, are not more important from the elucidation of the effects of this poison, than from the strange display of professional testimony to which it gave origin, (see *Appendix*, page 243.) There are those who still profess to believe that the prisoner was unjustly convicted upon that occasion; *Dr. Male* states, without the least reserve, that it was neither proved that the deceased was poisoned, nor that any poison had

existed. (*a*) We feel no difficulty in declaring that we hold a directly opposite opinion; and we consider that many of the weaker points of professional evidence delivered on the trial, have received powerful support and elucidation from the experiments and observations of later physicians.

Nor are the leaves of this plant wholly free from danger; it is true that they have, for many years, been in general use among cooks, to communicate an almond or kernel-like flavour to custards, puddings, creams, *blanc-mange*, and other delicacies of the table; but the custom has not always been harmless; a fact with which it behoves the forensic physician to be acquainted. In some parts of the continent milk is boiled with one or two leaves of the cherry-laurel in it, and *Ingenhouz* states that he saw people much affected by it. In the *Literary Chronicle* (no. xxii, p. 348, 1819) we find the following illustrative case: "Several children at a boarding-school, in the vicinity of Richmond, having partaken of some custard flavoured with the leaves of the cherry-laurel, four of them were taken severely ill in consequence. Two of them, a girl of six, and a boy of five years of age, fell into a profound sleep, out of which they could not be roused for ten hours, the other two complained of severe pains in the epigastric region. By proper medical treatment, they all recovered, after an illness of three days."

The essential oil of *bitter almonds* is equally poisonous; and the water distilled from them is highly

(*a*) The merits of this case are to be found very fully discussed in a pamphlet, entitled "Considerations on the criminal proceedings of this country; on the danger of convictions on circumstantial evidence, and on the case of *Mr. Donellan*." By a barrister of the Inner Temple, London, 1781.

dangerous if incautiously taken. *Duvignau* and *Parent* instituted some experiments upon themselves to ascertain this fact; they commenced by taking six dops of the water distilled three times, in an appropriate vehicle, without producing any other than a transient impression. On taking *eighteen* drops, however, vertigo was experienced, and a disposition to sleep, accompanied with a tingling of the ears and dimness of sight. When the dose was increased to *twenty-two* drops, alarming symptoms followed, such as convulsions, and vomiting; which, although the experimenters succeeded in allaying by antispasmodics, cured them completely of any ulterior wish to ascertain how far this substance might be deleterious. A drachm of the distilled water of bitter almonds has killed a moderate sized dog. The *essential oil* is proportionally more active; *Mr. Brodie* (*a*) found that one drop, when applied to the tongue of a cat, killed it in five minutes; no sooner did the poison come in contact with the organ than the animal was seized with convulsions. When two drops of the same oil were injected with half an ounce of water into the rectum of a cat, it was not seized for two minutes, but it died, as in the former experiment, after the expiration of five minutes. While engaged in this inquiry, *Mr. Brodie* dipped the blunt end of a probe into the essential oil, and applied it to his tongue, with the intention of tasting it, and not having the least suspicion that so small a quantity could produce any of its specific effects on the nervous system; but scarcely had he applied it, when he experienced a very remarkable and unpleasant sensation,

(*a*) "Experiments and Observations on the different modes in which Death is produced by certain vegetable poisons." Phil. Trans. vol. 101, for the year 1811.

which he referred chiefly to the epigastric region, but the exact nature of which he could not describe, because he knew nothing similar to it. At the same time there was a sense of weakness in his limbs, as if he had not the command of his muscles; and he thought that he should have fallen. The fascinating liqueur noyau, *créme de noyau*, is indebted for its flavour to the essential oil of the bitter almond, or peach; and is undoubtedly deleterious if taken in excess. In the *Journal des Debats*, for 1814, we find that the late *Duke Charles de Lorraine* had nearly lost his life from swallowing some drops of *eau de noyau* too strongly impregnated with the essential oil of peach kernels.

The bitter almond itself, in consequence of the manner in which its deleterious principle is modified by the natural state of combination in which it exists with sweet oil and albumen, does not produce an effect corresponding with the proportion of essential oil which it yields. The experiments of *Orfila*, however, prove that the almond, in doses of a drachm, is destructive to cats; and there can be no doubt but that it would be equally deleterious to the human species; but the quantity required for the production of such an effect must ever prevent the bitter almond from becoming either the accidental or criminal instrument of death.

Physiological action of Prussic acid.

The numerous experiments, which have been made with this poison, have clearly established that its action is upon the nervous system, whose energies it would seem to extinguish without any ostensible injury to respiration and circulation; for in all those

animals which were killed by it, in the experiments of *Orfila*, *Brodie*, and others, the heart was found acting regularly, and circulating dark coloured blood, and in some cases this phenomenon was visible for many minutes after the animal was in other respects apparently dead. *Orfila* considers that he has fully demonstrated that these effects depend on the absorption of the poison, and its transmission to the brain through the medium of the circulation. We have accordingly placed Prussic acid in the second division of our classification. The essential oil of bitter almonds would, according to the experiments of *Mr. Brodie*, appear to act through the medium of the nerves, and it has accordingly been referred to our first division. This is undoubtedly an anomaly, which it is not easy to reconcile; the experiments, however, which led *Mr. Brodie* to the conclusion appear to us to warrant such a deduction; the instantaneousness with which the poisonous effects were produced, and the fact of its acting more speedily when applied to the tongue, than when injected into the intestines, although the latter presents a better absorbing surface, seem to oppose the idea of the oil requiring to be absorbed, before it can display its energies. *M. Vogel*, of Munich, has lately discovered some facts respecting the composition of this oil, which may perhaps hereafter lead to the true explanation of this apparent anomaly; this distinguished chemist succeeded in separating the Prussic acid from the volatile oil with which it is combined, by agitating the whole in a concentrated solution of potass, and distilling to dryness; the oil volatilized together with the water, while the residuum in the retort was found to contain *cyanide of potassium*. The oil, thus separated from the Prussic acid, is

without odour, and heavier than water; its taste is extremely acrid and burning; in order to discover whether it was still poisonous, *M. Vogel* put a drop of it on the tongue of a sparrow, when it died in a few seconds, after a very violent convulsion; he also poisoned a dog, two months old, with four drops of it; whence he concludes that the volatile oil, divested of its hydro-cyanic acid is still a poison, although less energetic than that which has not undergone such a change. Do there exist then two independent principles of activity in the *bitter almond?* If such a fact were established it would not be solitary, for we shall hereafter shew that the energies of *tobacco* are dependant upon an analogous arrangement; and that our ignorance of the fact, at first, occasioned apparent anomalies, as embarrassing as those which at present involve the physiological history of the oil of almonds.

Antidotes.

Orfila, in his celebrated Toxicology, informs us that vinegar, or the vegetable acids; coffee; a solution of chlorine in water; camphor; emollient drinks; and bleeding, have been successively, but not succesfully recommended. (*a*) With respect to the first of these pretended *antidotes*, it deserves notice, that instead of palliating the symptoms, it actually quickens, and gives more energy to the action of the poison. Coffee, as far as it may stimulate, might be employed with advantage; but its powers are not sufficient to meet the exigency of the case. Bleeding seems decidedly

(*a*) To those who may wish to gain further information upon this subject, we beg to recommend the perusal of *Dr. Granville's* work above quoted.

a fatal measure. The authors of the paper on Prussic acid, inserted in the *American Recorder*, consider at length the claims of every substance which has been proposed as an antidote to it; and they conclude by saying that, we are entirely ignorant of a counter-agent of this poison. There is every reason, says *Dr. Granville*, to believe that the Prussic acid taken in large quantities, and in its concentrated state, is partially, if not wholly absorbed ere it *reaches the stomach*;—else how happens it that scarcely a minute after its exhibition, I have, in common with others, been unable to detect its presence within that organ. If so, then all chemical attempts must be nugatory, no decomposition, or fresh combinations can be produced to render it harmless; nor will an emetic, although so much recommended, be of much more service in freeing the system of its presence. But although chemical remedies are thus shewn to be of no avail, we may derive from the class of vital agents some powerful antidotes; all medicines taken from the class of diffusible stimuli will be useful in supporting the powers of the system against the sedative influence of the poison. Hot brandy and water, with ammonia, camphor, and other similar stimulants, are the resources to which we should fly upon such occasions.

Organic lesions discovered on Dissection.

The recorded dissections of persons, who have been poisoned by Prussic acid, are too few and vague to furnish any satisfactory generalization. In the case related by *M. Foderé*, of two servants who died after a draught of laurel-water, the dead bodies were carried to the University at Turin, and examined,

when the stomach was found slightly inflamed, but the other parts were in a sound state. We feel much hesitation in giving credit to this report, the death was too immediate to allow the access of inflammation; we are rather disposed to consider the appearances of the stomach to have arisen from that species of sanguineous congestion, which we have before alluded to, as sometimes occurring in cases of sudden death. In other cases the coats of the stomach are said to have been black and relaxed; the vessels of the brain injected; the lungs have also been described as presenting unnatural congestions, and purple spots; and the smell of Prussic acid seemed as if it pervaded the whole system, and was embodied, as it were, with the very substance of the muscles. In other cases, again, not the slightest trace of any morbid appearance could be discovered. Some authors have stated that in cases of death by this poison the cornea of the eye does not collapse, but retains its fulness, and even its lustre, for a considerable period.

Chemical processes by which the presence of hydrocyanic acid may be ascertained.

The strong odour yielded by the body on dissection, will furnish a satisfactory proof of the presence of this poison. Instances may occur, when the practitioner will be called before a tribunal to answer, from his professional knowledge, whether a particular case of death can have happened from the action of the hydro-cyanic acid, or any of the compounds in which it may enter as an ingredient; it therefore becomes an object of great importance to inquire whether any farther tests might be made subservient to our purpose. *Dr. Granville*, who has directed a

great share of his attention to the history of this poison, has given some directions upon this point, which appear to us to be useful and judicious; we shall, therefore, present them to our readers. "After collecting the blood contained in the ventricles of the heart, a portion of the contents of the stomach, and of the superior intestines, together with a certain quantity of any fluid which may chance to be present within the cavity of the head, chest, or abdomen; and having agitated the mixture for some time in distilled water, and filtered the liquid, taking care to keep the whole at a low temperature, proceed to the following experiments.

A. To a small quantity of the liquid add a few drops of a solution of caustic potass in alcohol.

B. To this, a few drops of a solution of sulphate of iron must be added, when a cloudy and reddish precipitate, of the colour of burnt *Terra-Sienna* will fall down.

C. Some sulphuric acid is now to be introduced into the tube, when the colour of the precipitate will instantly change to that of a bluish-green, which by a permanent contact with the atmosphere, becomes gradually of a beautiful blue, assuming at the same time a pulverulent aspect.

OR

A. Treat the filtered liquid with carbonate of potass.

B. Add a solution of sulphate of iron with a small quantity of alum: a precipitate, as in the former method, will fall down, which if treated by free sulphuric acid, will also be-

come blue and pulverulent. During this latter part of the experiment, there is a disengagement of carbonic acid.

Evidence may be pushed still farther, and the existence of the Prussic acid proved in a most positive manner by decomposing the precipitate, above described, and which is a true Prussian blue, so as to separate the acid. For this purpose, heat the precipitate with an equal quantity of tartaric acid, in a glass retort, at the temperature of 150°, when the hydro-cyanic vapours will soon exhale from the mixture, and may be received in water." (*a*)

Cl. V. NARCOTICO-ACRID POISONS.

We have already stated our objections to this division, and our apology for adopting it. *See page* 205.

Deadly Nightshade. *Atropa Belladonna.*

(Pentandria Monogynia. *Nat. Ord.* Luridæ *Linn.* Solanaceæ. *Juss.*)

This plant is an indigenous perennial, found in many parts of Great Britain, particularly in shady places where the soil is calcareous, in large ditches, and on the edge of hilly woods; flowering in June, and ripening its berries in September. Every part of the plant is poisonous; and numerous instances have occurred where children, and the ignorant, or those suffering from hunger, allured by the beautiful and tempting appearance of the berries, have fallen victims to their deadly power. The root of this plant

(*a*) Treatise on Prussic acid, sup. citat. p. 96.

partakes also of the same qualities as the leaves and berries, but is perhaps less virulent.

> " Or have we eaten of the *insane root*,
> That takes the reasoner prisoner."—*Macbeth.*

The inspissated juice (*Extractum Belladonnæ Pharm. Lond.*) is also extremely poisonous, when properly prepared; but, as usually met with in commerce, it is of very variable strength; when prepared according to the improved process of *Mr. Barry*, its activity is so considerable that a dose of two grains is followed by unpleasant effects. (*See an account of its effects in the Pharmacologia, vol. 2, p.* 199.) *M. Brandes* has lately ascertained that the active principle of this plant is a peculiar alkaline body, to which he has assigned the name of *atropia.*

Symptoms of poisoning by Belladonna.

Shortly after the ingestion of the berries, leaves, or root, of this plant, the patient complains of extreme dryness of the lips, tongue, palate, and throat; the deglutition becomes difficult, and the pupil of the eye immoveably dilated; nausea, rarely followed by vomiting; symptoms of intoxication succeed, accompanied with fits of laughter, dreadful ravings, violent gestures of the body, and continual motion of the hands and fingers; sometimes the patient sinks into a state of fatuity, but rarely of stupor; redness and tumefaction of the face, a low and feeble pulse, paralysis of the intestines, livid spots on different parts of the body, profuse sweats, convulsions, and death. In the cases where recovery has taken place, there has been an insensible restoration to health and reason, without any recollection of the preceding state.

Physiological action of Belladonna.

The results of the experiments of *Orfila* authorise us to arrange the nightshade under the second division of our classification; for it is evidently absorbed, carried into the circulation, and is thus enabled to act upon the nervous system, and particularly on the brain. At the same time it exerts a local action upon the stomach, although less violent than that occasioned by the acrid poisons. It, moreover, appears on some occasions to act directly through the medium of the nerves, like those substances which constitute our first class; or else how shall we explain the fact of the pupil of the eye becoming permanently dilated, by the contact of the belladonna with the tunica conjunctiva? It would, therefore, appear that this plant unites within itself all the three great modes of action, upon which we have attempted to found our physiological arrangement of poisons, as expressed by the tabular classification at page 207.

Organic lesions discovered on dissection.

The bodies of those who have perished by belladonna, are extremely prone to decomposition; they soon putrefy, swell remarkably, and are covered with livid spots; blood flows from the mouth, nose, and eyes, and the stench is insufferable. The stomach and intestines will sometimes display extensive marks of inflammation, extending in some cases to the mesentery and liver; and several cases are recorded in which the stomach appeared ulcerated. The lungs are usually found livid, gorged with venous blood, and studded with black spots; the heart has been also observed to be livid.

Modes of detecting the presence of Belladonna.

Where the berries of this plant have been swallowed, we shall generally detect them in the matter vomited; or, in the event of death, in the stomach, on dissection, for they would appear to be very indigestible; in a case of poisoning by this plant, recorded in the history of the French Academy for the year 1706, (*a*) the stomach was found to contain some berries of the belladonna crushed, and some seeds. Where the quantity of the plant is sufficient, we may proceed to identify it, by obtaining *atrophia* (*b*) from it. For this purpose, the leaves, or the crushed berries, or any other part of the suspected plant, must be boiled in distilled water; the decoction must then be pressed out, and filtered; after the albumen has been thrown down by a little sulphuric acid, potass must be added as long as any precipitate is produced; when the precipitate is to be washed in pure water, re-dissolved in muriatic acid, and re-precipitated by ammonia. This last result will be *atropia*. It is white, and collects in acicular crystals, insipid, little soluble in cold water, or even in alcohol, but very soluble in this latter fluid at a boiling temperature, from which, however, it is deposited on cooling.

STRAMONIUM. *Thorn-Apple. James-town Weed.*
Datura Stramonium (Pentandria Monogynia. *Nat. Ord.* Solanaceæ, *Linn.* Solaneæ, *Juss.*)

The thorn apple is an annual plant, a native of America, which gradually diffused itself, from the

(*a*) Journal General de Médecine, l. xxiv, p 224.
(*b*) Annals of Philosophy, vol. i, p. 2, *new series.*

south to the north, and is now naturalized to this country, and is to be found very commonly about London growing on dunghills, and by road sides. It flowers in July and August. Every part of this plant is a strong narcotic poison, producing vertigo, and most of those symytoms which we have described as the effects of belladonna, although the former plant appears to excite the brain more violently. *Dr. Barton* mentions the case of two British soldiers, who ate it by mistake, for the *chenopodium album;* one became furious, and ran about like a madman; and the other died, with the symptoms of genuine tetanus. In the fifth volume of the *Edinburgh Medical and Philosophical Commentaries*, two cases are related by *Dr. Fowler;* and others are to be found in the writings of *Haller*, *Krause*, *Sproegel*, *Gmelin*, and *Orfila*, illustrative of the effects of this plant upon the human species. There is reason to believe that this plant has been long known, and that it has been very generally used by uncivilized nations, on account of the narcotic effects which it occasions.

Tobacco. *Nicotiana Tabacum.*

(Pentandria Monogynia. *Nat. Ord.* Luridæ, *Lin.* Solaneæ, *Juss.*)

Tobacco is an annual plant, a native of America, from whence it was imported into Europe. We learn from *Humboldt* that it has been cultivated from time immemorial by the native people of the Oroonoko; and was smoked all over America at the time of the Spanish conquest. *Hermandez de Toledo* sent it into Spain and Portugal in 1559, when *Jean Nicot* (*a*)

(*a*) From this person the plant received its generic name, *Nicotiana;* the specific appellation being taken from *Tabac*, the name of an instrument used by the natives of America in smoking the herb.

was Ambassador at the court of Lisbon, from Francis II, and he transmitted, or carried either the seed, or the plant to *Catherine de Medicis*, as one of the wonders of the new world, and which, it was supposed, possessed virtues of a very extraordinary nature. This seems to be the first authentic record of the introduction of this plant into Europe. In 1589 the Cardinal *Santa Croce*, returning from his nunciature in Spain and Portugal to Italy, carried thither with him tobacco; and we may form some notion of the enthusiasm with which its introduction was hailed, from a perusal of the poetry which the subject inspired. It is said that the smoking tobacco was first introduced by *Sir Walter Raleigh* on his return from America; and the avidity with which the custom was immediately adopted is shewn by the philippic written against it by King James, entitled the "*Counterblaste to Tobacco.*"

As an object of Medical Jurisprudence, its claims to our attention are numerous and important; not only as having occasionally been the means of destroying human life, but as furnishing, in its most romantic history, a striking illustration of the triumph of popular opinion over a series of legislative enactments (*a*) which had no other origin than that of ignorance and prejudice.

(*a*) In 1624 Pope Urban the VIII, published a decree of excommunication against all who took snuff in the church. Ten years after this, smoking tobacco was forbidden in Russia, under the pain of having the nose cut off. In 1653 the Council of the Canton of Appenzel cited smokers before them, whom they punished; and they ordered all innkeepers to inform against such as were found smoking in their houses. The police regulations of Berne, made in 1661, were divided according to the ten commandments, in which the prohibition of smoking stood immediately beneath the command against adultery. This prohibition was renewed in 1675, and the tribunal instituted to put it into execu-

Tobacco was at one period of our history raised to a considerable extent in Yorkshire; but the cultivation of it for the purposes of trade have been long prohibited; and this country, as well as the greater part of Europe, is chiefly supplied from Virginia, where the plant is cultivated in the greatest abundance. The recent leaves do not possess any considerable odour, nor have they much flavour; when dried, however, their odour becomes strong, narcotic, and somewhat fœtid; their taste bitter, and extremely acrid. We have stated, upon another occasion, (*a*) that tobacco would appear to contain two independent elements of activity, an essential oil, and a proximate principle, of an acrid nature, to which *Vauquelin* has bestowed the name of *Nicotin*. The essential oil is an extremely virulent poison. *Mr. Barrow*, speaking of the use which the Hottentots make of it for destroying snakes, says, "A Hottentot applied some of it from the short end of his wooden tobacco-pipe to the mouth of a snake, while darting out his tongue. The effect was as instantaneous as an electric shock; with a convulsive motion that was momentary, the snake half untwisted itself, and never stirred more; and the muscles were so contracted, that the whole animal felt hard and rigid, as if dried in the sun." The author has ventured a conjecture in his *Pharmacologia*, (*b*) with respect to this virulent

tion—viz. "CHAMBRE AU TABAC," continued to the middle of the eighteenth century. Pope Innocent the XII, in 1590 excommunicated all those who were found taking snuff, or using tobacco, in any manner, in the church of St. Peter at Rome; even so late as 1719 the Senate of Strasburgh prohibited the cultivation of tobacco, from an apprehension that it would diminish the growth of corn. Amurath the IV published an edict which made the smoking tobacco a capital offence; this was founded on an opinion that it rendered the people infertile.

(*a*) Pharmacologia, vol. 1, 228, and vol. 2, art. Tabaci Folia.

(*b*) Vol. ii, p. 404.

oil, which he takes this opportunity of repeating, that "*the juice of cursed hebenon*," by which, according to *Shakspeare*, the King of Denmark was poisoned, was no other than the essential oil of tobacco.

> ——— "Sleeping within mine orchard,
> My custom always of the afternoon,
> Upon my secure hour thy uncle stole,
> With juice of *cursed hebenon* in a vial,
> And in the porches of mine ears, did pour
> The leperous *distilment*."

In the first place, the learned commentator *Dr. Gray* observes, that the word here used (*hebenon*) was more probably designated by a *metathesis*, either of the poet or transcriber, for *henebon*, i. e. henbane. Now it appears from *Gerarde* that *tabaco* was commonly called "*henbane of Peru*" (Hyoscyamus Peruvianus); and when we consider how high the prejudice of the court ran against this herb, as so strikingly evinced by the '*Counterblaste*' of King James, it seems very likely that *Shakspeare*, who was fond of playing the courtier, should have selected it, as an agent of extraordinary malignity, upon such an occasion. No preparation of the *hyoscyamus* with which we are acquainted, would produce death by an application to the ear; whereas the essential oil of tobacco might, without doubt, occasion a fatal result. The term *distilment* has also called forth a remark from *Steevens*, which is calculated to add a little farther weight (*a*) to our conjecture; "surely" says he, "this expression signifies, that the preparation was the result of a *distillation*."

(*a*) We are, however, by no means disposed to assign greater weight to this expression that it can fairly sustain; it may perhaps refer to the operation of dropping the poison into the ear, and not to the poison itself—thus *Juvenal*, "*stillavit* in aurem."

Symptoms of poisoning by Tobacco.

The leaves of tobacco, whether whole, or reduced to powder, as they are daily met with in commerce, or in the form of infusion in water or wine, or in the state of smoke, are endued with poisonous properties of extreme energy. Their administration is shortly followed by vertigo; severe nausea; vomiting; a general tremor of the body, which is rarely the result of any other poison; cold sweats; syncope; and death. The author remembers witnessing a lamentable exemplification of the action of tobacco upon a person labouring under a strangulated hernia. The patient had been under the care of a medical practitioner in the vicinity of London, who after repeated and fruitless efforts to return the intestine, injected an infusion of tobacco into the rectum, and sent him in a carriage to the Westminster hospital, for the purpose of undergoing the operation; but the unfortunate man expired very shortly after his arrival, in consequence of the effects of the tobacco clyster. The external application of tobacco, in the form of cataplasm, or infusion, will occasion all the effects above related. A woman applied to the heads of three children afflicted with *tinea capitis*, a liniment consisting of powdered tobacco and butter, soon after which they experienced vertigo, violent vomiting, and fainting. (*a*)

It was formerly a practice to inject the smoke of tobacco into the anus, by means of a bellows of a peculiar construction, in cases of suspended animation, with a view to *stimulate* the rectum, and thereby to revive the vital powers; we have already commented

(*a*) Ephemerides des Curieux de la Nature, Dec. ii, An. i, p. 46.

upon this most dangerous and mistaken notion, (*see page* 88.)

In the process of *smoking* tobacco, the oil is separated, and being rendered empyreumatic by heat, it is thus applied to the fauces in its most active form; whence vertigo, nausea, and all its characteristic symptoms speedily arise upon that occasion; although the system becomes easily habituated to the action of this narcotic, and we continually see a large portion of the community using it daily, in various ways, and in great quantities, as a luxury, without experiencing any other bad effect than that which arises from their inability to relinquish the habit.

The well known errhine, *snuff*, is prepared from the dried leaves of tobacco, and possesses all the powers of the plant. The celebrated *Santeuil* experienced vomiting and horrible pains, amidst which he expired, in consequence of having drank a glass of wine, into which some Spanish snuff had been introduced. (*a*)

Physiological action of Tobacco.

The deleterious effects of this plant appear to depend on an especial action upon the nervous system; but farther experiments are required to establish through what medium its powers are conveyed to the sensorium. *Orfila* concludes that the active part of the plant is absorbed, and carried into the circulation. *Mr. Brodie's* experiments, however, would lead to the conclusion that it operates through the medium of the nerves; and, what is extremely singular, they shew that the *essential oil* operates very differently

(*a*) *Orfila*, Toxicol.

from the *infusion* of tobacco; for that while the former appears to act exclusively on the brain, leaving the power of the circulation unimpaired, the latter acts on the heart at once, suspending its action even before the animal ceases to respire, and kills by producing syncope. This apparent anomaly at first led *Mr. Brodie*, as he has since informed the author, to suspect the accuracy of his experiments; but their careful repetition rendered this impossible. We suggested to him, whether a probable explanation might not be found in the late chemical results respecting the composition of tobacco, which seemed to shew that this plant possesses two active elements. (*a*).

Hemlock. *Cicuta.* (*b*)

Conium (*c*) *Maculatum* (Pentandria Digynia. *Nat. Ord.* Umbellatæ.)

Hemlock is a biennial, umbelliferous, indigenous plant, growing very commonly about the sides of fields, under hedges, and in moist shady places. It is at once distinguished from other umbelliferous plants, with which it may be confounded, by its *large* and *spotted* stem, the dark and *shining colour of its lower leaves*, and their *disagreeable smell;* which, when fresh and bruised is said to bear a strong resemblance to that of the urine of a cat. Many (*d*) cases of

(*a*) Pharmacologia, vol. I, p. 228.

(*b*) Pliny informs us that the word *cicuta* amongst the ancients, was not indicative of any particular species of plant, but of vegetable poisons in general. We have already made the same remark with respect to Aconite.

(*c*) Κώνειον of Dioscorides.

(*d*) In the London Medical and Physical Journal, vol. 14, p. 425, we shall find a case wherein the hemlock was eaten through mistake for common parsley. Similar accidents are also recorded in *Miller's* Dictionary.

persons who have been poisoned by this plant are to be found in the writings of different toxicologists. The extract, if properly prepared, is a very energetic substance, and gives rise, in large doses, to all the symptoms which we have so often described as the result of narcotic poisons. In those fatal cases, where the bodies have been examined, *post mortem*, inflammation of the stomach, and sanguineous congestion in the brain, have been the most prominent phenomena. It would appear that the active element of this plant is absorbed and carried into the circulation, through which medium it exerts its action on the nervous system, and more particularly on the brain. At the same time it seems to excite a local irritation, capable of producing an inflammation more or less violent. The best antidote is vinegar, after the stomach has been evacuated, and the cerebral excitement reduced by bleeding and purging.

The *Cicuta Virosa*, or *water hemlock*, with which the *conium maculatum* has been often confounded, is still more virulent; it is however to be distinguished from the latter, by having its hollow roots always immersed in water, while those of the *conium* never are. *M. Orfila* has related several cases of poisoning by the *water hemlock*.

Nux Vomica.

This is the seed of the *Strychnus Nux Vomica* (Pentandria Monogynia, *Nat. Ord.* Apocyneæ, *Juss.*)

The tree (*a*) which produces these seeds grows in Ceylon, upon the coast of Coromandel, and in Malabar. The nux vomica is round and flat, about an inch broad, and nearly a quarter of an inch thick,

(*a*) It is figured in the Hortus Malabaricus under the name of *Caniram*.

with a prominence in the middle on both sides, of a grey colour, covered with a kind of woolly matter, but internally hard and tough. The kernel discovers to the taste a considerable bitterness, but makes little or no impression on the organs of smell. There is a popular belief that this substance is poisonous to all animals, except man. Instances, however, are not wanting to illustrate its deleterious effects upon the human species. It proves fatal to dogs in a very short period; it has also poisoned hares, foxes, wolves, cats, rabbits, and even some birds. *Loureiro* relates that a horse died in four hours after taking a drachm of the seed in an half roasted state. Its effects, however, on different animals, and even on those of the same species, are somewhat uncertain, and not always in the proportion to the quantity given. With some animals it produces its effects almost instantaneously; with others, not until after the lapse of several hours, when laborious respiration, followed by torpor, tremblings, coma, and convulsions usually precede the fatal spasms, or *Tetanus*, which so especially distinguishes the operation of this poison. *Hoffman* reports the case of a young girl of ten years of age, who, labouring under an obstinate quartan fever, took, at two doses, fifteen grains of nux vomica, and died very shortly afterwards. *MM. Pelletier* and *Caventou* have discovered in these seeds, a peculiar proximate principle, to which their virulence is owing; it was originally named *Vauqueline*, in honour of the celebrated French philosopher, but in deference to the opinion of the French Academy of Sciences, the discoverers have substituted the name *Strychnia*, (*a*) because "a name dearly loved, ought not to be applied to a noxious principle!"

(*a*) Annales de Chimie, t. 8 to 10.

Strychnia is highly alkaline, and crystallizes in very small four-sided prisms, terminated by four-sided pyramids; its taste is insupportably bitter, leaving a slight metallic flavour, and is so powerful as even to be perceptible when a grain is dissolved in eighty pounds of water; (*a*) it has no smell. So extreme is its activity upon the animal system, that in doses of half a grain it occasions serious effects, and in larger ones, convulsions and death. It is, perhaps, the most powerful, and, next to *hydro-cyanic acid*, the most rapid of poisons. *M. Majendie* has killed a dog with one-eighth of a grain; and the editor of the *Edinburgh Medical and Surgical Journal* has seen one die in two minutes after the injection of one-sixth of a grain into the cavity of the pleura.

Nux vomica is supposed by *Orfila* to exert a specific action on the spinal marrow, thereby producing tetanus, immobility of the thorax, and consequently asphyxia, of which the animal dies. That this effect is produced by the absorption of the poison, and its passage into the circulation, is clearly established by the interesting and important experiments of *M. Majendie*. (*b*)

Cocculus Indicus.

This is the fruit of a shrub (*Menispermum Cocculus*) which grows naturally in the sand, in the midst of the rocks, on the coast of Malabar, in the island of Ceylon, and in other parts of the East Indies.

(*a*) Ibid. t. x, 153.

(*b*) Journal de Physiologie Experimentale, 1er numero---Janvier 1821, in a paper entitled "*Memoire sur le Méchanisme de l'Absorption.*"

The berries are imported into this country in a dry and shrivelled state. In India they are employed for killing fish, which they intoxicate and poison, when thrown into fish ponds. *M. Goupil*, a physician of Nemours, communicated to the Society of Medicine some interesting facts on the subject of this poison; (*a*) and he has shewn that it is not only destructive to fishes, but also to different carnivorous quadrupeds, and, very probably, to man. He also states that the poisonous principle of this substance is not sensibly changed by the gastric juices, and the vital action of the organs of digestion; but, on the contrary, that it passes into the absorbent system with all its properties unimpaired; and that the flesh of those fishes which have eaten it, irritates the stomach and bowels of the animals to which it is given, nearly in the same manner as the *Cocculus Indicus* itself. All the fishes who eat it do not die in an equal space of time. *Roach*, *pollard*, *breme*, *perch*, *tench*, and *barbel*, are affected in an order corresponding with that in which they are here arranged; the *roach* is killed the easiest of all; the *barbel* is the last to die, and is moreover said to be, of all fish, the one whose flesh the most frequently occasions accidents in those animals who eat it; probably, says *M. Goupil*, because these fish, taking a longer time to die, the poison is longer subjected to the action of the digestive juices, and a considerable quantity of it is consequently absorbed. (*b*)

Late experiments (*c*) have shewn that the active principle of the *cocculus Indicus* is an alkaline body,

(*a*) We avail ourselves of this report, as given by *Orfila* in his System of Toxicology.

(*b*) Bulletin de la Société de Med. Nov. 1807.

(*c*) Analyse Chimique de la Coque du Levant. Paris, 1812.

crystallizable, bitter, and extremely poisonous; to this principle, *M. Boullay* has given the name of *picrotoxine*, and the experiments of *M. Orfila* have confirmed the idea of its constituting the only active element of the seeds.

Poisonous Mushrooms.

The common mushroom, or champignon, (*Agaricus Campestris*) has been long esteemed an article of epicurean delicacy; and is eaten in its fresh state either stewed or boiled; and as a preserve, in the form of pickle or powder. Its juice, moreover, furnishes the sauce so well known by the name of *ketchup*, (*a*) or *catsup*. *Mr. Miller* informs us that the true eatable mushroom may be easily distinguished from the poisonous and unpleasant species by the following characters. "When young, it appears of a roundish form, smooth, like a button; which together with its stalk, is white, especially the fleshy part of the button; the gills within, when broken, are livid. As it grows larger, it expands its head by degrees into a flat form; the gills underneath are at first of a pale flesh-colour, but become blackish on standing." There are besides a vast number of species which may be eaten with perfect impunity; the Agaricus *Procerus*, or tall mushroom, is sometimes exposed for sale in Covent Garden market, and is quite harmless; although, when preserved in pickle, it is very apt to run into the vinous fermentation. With equal safety the Agaricus *Pratensis*, or Scotch bonnet, as it has been called, may be eaten; it occurs in those patches which are

(*a*) We have already stated that this sauce has been occasionally rendered poisonous by the presence of copper, p. 290.

well known by the popular name of *fairy rings*. The Agaricus *deliciosus* is considered by *Withering* to have been the mushroom which formed the vehicle of poison to *Claudius Cæsar*, as related at page 134 of this volume, and which has been celebrated by the satiric pen of *Juvenal*, and the epigrammatic muse of *Martial*; a species of mushroom, observes *Withering* which is still highly esteemed in modern Italy, as it was in ancient Rome. *Schæfer* and *Clusius*, however, consider the plant in question to have been the Agaricus *Xerampelinus*, a species which although esculent, has a strong, and by no means an agreeable flavour. The common champignon has never, as far as we can learn, produced any mischief, although a popular opinion prevails that soil, shade, and other local circumstances, may render it virulent. If any unpleasant symptoms were to follow its ingestion, we should be inclined to regard them as the result of the peculiar idiosyncrasy of the individual, rather than as the consequence of an *absolute* poison; indeed a question has been raised how far such an explanation may not apply to all the cases of poisoning from this tribe of plants; for it has been observed that in many parts of Europe several of those species of mushroom are eaten with impunity, that are regarded by us as most virulent poisons; of this number we may reckon the Agaricus *Piperatus*, or *Pepper Agaric*, which is eaten in great quantity by the Russians, who fill large vessels with them in the autumn, seasoning or pickling them with salt, and then eating them in the ensuing lent. (*a*) There is, however, too much direct evidence in favour of the existence of an acrid poison in certain *Agarics*, to allow the supposition of their

(*a*) *Haller*, Helvet. hist.

being *relative* (*a*) in their operation, as exemplified in the history of the *Agaricus Muscarius*, or *Bug-agaric*, which is so called from its power in destroying these insects; and for which purpose the inhabitants of the north of Europe infuse it in milk, and set it in their windows. It constitutes the *Mouchomore* of the Russians, Kamtschadales, and Koriars, who use it for the sake of intoxication; upon some occasions they eat it dry, but generally it is steeped in a liquor made with the *Epilobium Angustifolium;* upon drinking which, they are seized with convulsions in all their limbs, followed by raving delirium: an effect which renders it a desirable potation (*b*) to those who intend to accomplish any desperate act, or premeditated assassination. It is also stated that those who drink the urine of persons intoxicated by this agaric, experience the effects of the mushroom. *Withering*, (*c*) who has been very assiduous in the display of this species, acknowledges ten varieties, all of which are natives of Britain. The *Agaricus Semi-globatus* of this botanist, and which is identical with the A. *Glutinosus* of Curtis, is extremely poisonous, and has proved fatal in several instances in this country. There are a great many other species equally destructive, but notwithstanding the labour that has been bestowed upon this branch of natural knowledge, much remains to be explained. The ancients appear to have taken considerable pains in discriminating between esculent and poisonous fungi; among the moderns, *Clusius* has furnished a mass of information. *Withering* has described with

(*a*) We have explained, at page 150, the sense in which we wish these terms to be received.

(*b*) Krascheminckow, Histoire Naturel du Kamtschatka, p. 209.

(*c*) Systematic arrangement of British Plants, vol. iv, p. 181.

great botanical minuteness and accuracy the different species and varieties of this extensive genus of the cryptogamia; but he has failed in pointing out the poisonous, from the esculent and harmless species. *Orfila*, in his late lessons on Poisons, (*a*) has bestowed considerable labour with a view to establish a practical distinction, and has enriched his work with highly illustrative engravings. Upon the present occasion, it is scarcely necessary to observe, that it would be foreign to the plan of this work to enter into such botanical details as the full elucidation of this subject would require; the research would, in itself, occupy a quarto volume; we must therefore rest satisfied with general observations. The following indications should excite a suspicion of mushrooms. A marshy and shady locality; an ugly or lurid physiognomy; a glairy or moist surface; a change of colour when cut, and a soft, porous, and moist texture; a virulent smell; a bright colour, or a combination of distinct colours. We ought also to reject as dangerous all those which have bulbous and soft stems, or which have fragments of skin glued to their surface.

Symptoms of poisoning by Mushrooms.

Exhilaration of spirits, laughter, vertigo, sickness, griping pains, vomiting, and purging, suffusion of the eyes, stupor, cold sweats, syncope, convulsions, death. Numerous records of sickness and death might be adduced in illustration of this subject. The celebrated musician, *Schobert*, and, with the exception of one child, his whole family, together with a friend and a physician who dined with him,

(*a*) Leçons, faisant partie du Cours de Medecine Legale de *M. Orfila*. Paris, 1821.

were all fatally poisoned by a dish of mushrooms, which he had himself gathered in the fields of Saint Gervais, a village in the environs of Paris. It is not known to what species the plants belonged. In the *Gazette de Santé*, for August 1812, we have the following narrative. "*M. Dufour*, a physician of Montargis, gathered in the neighbouring forest some mushrooms, which were stripped of their skin, and their stem, cut into pieces, and cooked in their juice with butter and fine herbs, under a camp oven. They were served up at table. The servant girl, aged twenty years, who had eaten the greatest quantity, very shortly complained of confusion of the head, giddiness, and a slight heaving of the stomach; her face was red and inflamed, the eyes starting and lively, the pulse full and undulating. The eldest daughter of *M. Dufour* experienced the same symptoms without any nausea. A little child, eighteen months old, that had only eaten some bread dipped in the gravy, slept quietly for sixteen hours, contrary to his usual custom, and exhibited no other remarkable phenomenon. The other child, aged eleven years, complained of confusion of the head and intoxication; the parents did not experience any ill effects. Upon investigation it was discovered that two mushrooms of the *Agaricus Muscarius*, having been confounded with the proper one, had entered into the composition of the dish.

Amongst the cases which have occurred in this country, we may particularize that related by *Mr. E. Brande*, in the third volume of the *London Medical and Physical Journal*, *p.* 41, "J. S. gathered early in the morning of the third of October, in the Green Park, what he supposed to be small mushrooms; these he stewed with the common additions in a *tin-*

ned iron (*a*) saucepan. The whole did not exceed a tea-saucer full, which he, and four of his children ate the first thing, about eight o'clock in the morning, as they frequently had done without any bad consequence; they afterwards took their usual breakfast of tea, &c, which was finished about nine, when *Edward*, one of the children (eight years old) who had eaten a large proportion of the fungi, was attacked with fits of immoderate laughter, nor could the threats of his father or mother restrain him. To this succeeded vertigo, or stupor; the pupils of his eyes were, at times, dilated to nearly the circumference of the cornea, and scarcely contracted at the approach of a strong light; his breathing was quick, his pulse very variable, at times imperceptible, at others too frequent and small to be counted, latterly very languid; his feet were cold, livid, and contracted; he sometimes pressed his hands on different parts of his abdomen, as if in pain, but when roused and interrogated respecting it, he answed yes, or no, evidently without any relation to what was asked. About the same time the father, aged forty, was attacked with vertigo, and complained that every thing appeared black, then wholly disappeared; to this succeeded loss of voluntary motion and stupor; in about ten minutes he gradually recovered, but complained of universal numbness and coldness, with great dejection, and a firm persuasion that he was dying; in a few minutes he relapsed, but recovered as before, and had several similar fits during three or four hours, each succeeding one being less violent, and with longer intermission than that preceeding.

(*a*) This fact is particularized, as some persons have supposed the symptoms which have arisen form the ingestion of these fungi, may have been the effect of copper derived from the cooking utensils.

Harriet, twelve years old, who had eaten but a very small quantity, was also attacked at the time with slight vertigo. *Charlotte*, a delicate little girl, ten years of age, who had eaten a considerable quantity, was suddenly attacked in the presence of *Dr. Burges* and myself, with vertigo and loss of voluntary motion. *Martha*, aged eighteen, who had eaten a small proportion, was attacked with similar symptoms." By judicious treatment they all recovered. Upon investigation *Mr. Sowerby* determined the mushroom to have been a variety of the A. *glutinosus* of Curtis (*Flora Londinensis*) the same with *Dr. Withering's A. semi-globatus;* and yet no notice of its deleterious properties is taken by either of these botanists.

A less fortunate case of poisoning by *Fungi* is related in the twentieth volume of the same journal by *Mr. Parrott*, surgeon of Mitcham, of which the following is a sketch. The subject of the history was a family of six persons, viz. *William Attwood*, ætat. 45; *Eliza*, his wife, 38; and their daughters, *Mary*, æt. 14; *Hannah*, 11; *Sarah*, 7; *Eliza*, 5. They all ate stewed champignons, at one o'clock, on Monday the 10th of October, which stew was made in an iron vessel, and consisted of the articles already mentioned with the addition of butter and flour, pepper, salt, and water only; and each of the parties (*Hannah* excepted) was supposed to have eaten more than half a pint. Within ten minutes after they had eaten their meal, they felt their spirits exhilarated, and the eldest daughter said to her mother "*how funny you look.*" All the parties continued cheerful till about six o'clock, when having taken their tea, they were attacked with stupor, which was soon succeeded by severe pains in the bowels, accompanied with violent vomiting, and copious purging, which continued

till the following afternoon, when the parents became alarmed and sent for the surgeon. The treatment which was pursued appears to have been, in every respect, judicious, and *Mary* had so far recovered on the following day (Wednesday) that she walked into the village about a quarter of a mile from home; in the evening, however, the symptoms returned; on Thursday evening she became convulsed, and died on Friday morning at two o'clock. *Eliza* did not complain much of her sufferings, but became convulsed at the same time as her sister, and died half an hour after her. *Sarah* never complained of pain in the head, but was continually suffering under extreme pain in the bowels, which was aggravated by pressure, but no tension existed; she died on Saturday morning, in the same convulsed state as her sisters. A dog which had partaken of the stew died on the Wednesday night, apparently in great agony. The father recovered, the mother, who was two months advanced in pregnancy, miscarried, but ultimately became convalescent. *Mr. Wheeler*, of St. Bartholomew's hospital, a gentleman who has been long known to the profession as an eminent botanist, no sooner heard of the event than he repaired to the spot where the mushrooms had been gathered, when he immediately recognised the *Agaricus semi-globatus*, which had nearly proved fatal in the instance related by *Mr. E. Brande*, and which, upon being shewn to the father, he instantly pronounced to be similar to those, of which the family had so unfortunately eaten.

Organic Lesions discovered on Dissection.

In the above case of the family of *Attwood*, the body of *Mary* was examined, but no morbid appearance whatever could be discovered. In collecting the different phenomena exhibited in other recorded cases, they may be reduced to the following: "violet coloured spots over the integuments; abdomen extremely bulky; the *tunica conjunctiva* of the eye as if it were injected; the pupil contracted; stomach and intestines inflamed, and scattered over with gangrenous spots; and, in some cases, they have exhibited very considerable contractions, so much so as almost to obliterate the canal. In no case have any remains of the mushroom been found. The lungs have been observed inflamed, and gorged with black blood."

There cannot, however, be any doubt but that the different species of poisonous agarics act very differently.

Antidotes.

In all cases, the first object is to evacuate the offensive matter by emetics. After which, stimulants, especially *ammonia*, will be found highly serviceable.

ALCOHOL.

In treating of the action of this substance upon the human body, it may be considered as a slow, or quick poison; as one which, according to the circumstances of its administration, may either implant the seeds of disease and death, by an insidious, and scarcely perceptible operation, or extinguish the principle of animation in the space of a few hours.

Its effects as an *accumulative* (*a*) poison are principally interesting to the physician in their relations to therapeutics, although their history may perhaps suggest some few points of interest to the founders of medical police.

We shall, therefore, observe, with regard to the habitual use of fermented liquors, that the bodily evils which arise from the custom rather depend upon the quality, or, in other words, the state of combination in which the alcohol exists in such liquors, than on the absolute quantity of the libation, or the frequency with which it is repeated. Daily experience convinces us that the same quantity of alcohol applied to the stomach under the form of wine, and in a state of mixture with water, will produce very different effects upon the living body, as well with reference to the immediate symptoms, as to the remote consequences of the potation; it has, for instance, been clearly demonstrated that port, madeira, and sherry, contain from one-fourth to one-fifth their bulk of alcohol; (*b*) so that a person who takes a bottle of either of these wines, will thus take nearly half a pint of pure alcohol, which is equivalent to a pint of brandy! The remote consequences too of alcohol in these different states, are as striking and distinct as their immediate effects. It is well known that diseases of the liver are the most common, and the most formidable of those produced by the use of *ardent* spirits; it is equally certain that no such disorders follow the intemperate use of wine that is perfectly *pure;* let it be remembered that the greater

(*a*) Let it be remembered that this term is to be received conventionally; we merely intend it to express certain phenomena, without any reference to their cause.

(*b*) *Mr. Brande.* Phil. Trans. 1811 and 1813.

proportion of that which is drunk in this country contains uncombined brandy, purposely added to meet the demand of the British market; and *Dr. Mac Culloch* thinks that it is to the unwitting and concealed consumption of this uncombined spirit, that we ought to attribute the prevalence of those hepatic affections which are comparatively little known to our continental neighbours. But although wine, in a state of purity, may be thus fairly excluded from the general obloquy which attaches to spirituous potations, it must not be regarded as entirely free from imputation. "The effects of wine," says *Rush* "like those of tyranny in a well formed government, are first felt in the extremities; while spirits, like a bold invader, seize at once upon the vitals of the constitution." And even with respect to ardent spirits, although they can only be regarded as diluted alcohol, still each species appears to possess a peculiarity of operation; owing, no doubt, to the modifying influence of the other elements of the liquid; thus *brandy* (*a*) is said to be cordial and stomachic; *rum* more heating and sudorific; *gin* and *whiskey*, diuretic; and *arrack*, styptic, heating, and narcotic. It seems also that a modified effect is produced by the addition of various other substances, such as sugar and acids; which latter bodies, besides their anti-narcotic powers, appear to act by favouring a more perfect combination and mutual penetration of the particles of spirit and water. The effects also which are produced by the habitual use of fermented liquors differ essen-

(*a*) "I apprehend that the peculiar flavour of *cogniac* depends upon the presence of an æthereal spirit, formed by the action of tartaric, or perhaps acetic acid upon alcohol. It is on this account that nitric æther, when added to malt spirits gives them the flavour of brandy." Pharmacologia, vol. 2, p. 396.

tially according to the kind that is drunk; thus ale and porter, in consequence of the nutritive matter, and perhaps the invigorating bitter with which they are charged, and the comparatively small proportion of alcohol which they contain, dispose to plethora, which is sometimes terminated by apoplexy. (*a*)

Symptoms of Poisoning by Alcohol.

The ordinary effects of an excessive dose of any spirituous liquor are too well known to require description; and generally pass off without the necessity of professional interference. In cases, however, where the draught has been very large, the person has suddenly fallen down in a state of complete insensibility, and has exhibited all the phenomena of apoplexy; or, in some instances, he has expired almost immediately. The insensibility of the patient may render it difficult for the practitioner to distinguish the immediate cause of the symptoms; although his history for the last few hours, and the spirituous odour of his breath, will generally announce the true nature of his situation. *Mr. Brodie* observes that there is a striking analogy between the symptoms arising from the ingestion of spirits, and those produced by injuries of the brain; concussion of the brain, which may be considered the slightest degree of injury, occasions a state of mind resembling intoxication; pressure on the brain, which is a more severe injury than concussion, produces loss of motion, insensibility, dilation of the pupils, laborious and stertorous respiration, and death.

(*a*) Pharmacologia, vol. 2, p. 897.

Physiological Action of Alcohol.

We shall not enter into the history of the slow operation of repeated doses of spirit upon the human body; but limit our present inquiry to the *modus operandi* of this agent, as a quick and destructive poison.

Large draughts of liquids containing alcohol, would appear to destroy, at once, the functions of the brain, without occasioning that previous stage of excitement, which is produced by smaller quantities of spirit—whence coma and insensibility are the immediate consequences; and the nervous energy being no longer conveyed to the muscles of respiration, the breathing becomes laborious, and the patient dies, as he does in apoplexy, for want of those changes in the blood which are produced by the respiratory functions. (*a*) In the greater number, however, of fatal cases of inebriety, life has been destroyed by circumstances purely accidental; such as improvident

(*a*) See our chapter on "*the Physiological causes and Phenomena of Sudden Death*," page 16.

In the course of the present work we have frequently recommended the artificial inflation of the lungs, in cases were life is liable to be extinguished by suffocation, (*page* 78); but we have not yet hinted at the possibility of employing such a resource with success in cases of narcotic poisoning, wherein the death may be physiologically considered as analogous to that occasioned by suffocation. *Mr. Brodie* was the first philosopher who ventured to propose such an expedient, and in an experiment carefully performed on an animal under such circumstances, its life was preserved.

The success of the process will depend upon our being able to keep up an artificial breathing, until the effects of the narcotic have passed away, and the energy of the brain is restored. As during this interval the generation of animal heat appears to be in a great measure suspended, it will be necessary to maintain a sufficient temperature by art.

exposure to cold, as explained at *page* 59, or suffocation from an imperfect act of vomiting, during which a portion of the contents of the stomach are forced into the trachea, (*see page* 58, (*a*).) It having then been clearly established that the brain is the organ principally affected by a large dose of alcohol, it remains to be explained in what manner, and through what medium such an effect is produced; upon this question we are inclined to concur with *Mr. Brodie*, and to consider that alcohol acts sympathetically on the brain by means of the nerves of the stomach; for it has been observed that animals which die under such circumstances, exhibit a decided inflammation of the stomach; and, in the next place, the effects produced by this agent are too instantaneous to admit the possibility of absorption, while repeated instances have shewn that vomiting will often restore the intoxicated individual to his senses. At the same time, we think it very probable that, upon some occasions, the alcohol passes into the current of the circulation, and is thus carried to remote organs. *Dr. Cooke* (*b*) has related a case, on the authority of *Sir A. Carlisle*, of a person who was brought dead into the Westminster hospital, in consequence of having drunk a quart of gin for a wager, at a draught; and that upon examination, a considerable quantity of a limpid fluid was found within the lateral ventricles of the brain, *distinctly impregnated with gin.* We well remember this case, for it occurred during the period that the author of the

(*a*) We have just received from *Mr. Alcock* a history of the particular circumstances of the interesting case alluded to at page 58 of the present volume, and we shall give insertion to it in our chapter on Anatomical Dissection.

(*b*) Treatise on Nervous Diseases, vol. 1, p. 221.

present work held the situation of physician to that hospital. See *Pharmacologia*, vol. 1, p. 138.

Treatment of Persons in a State of Inebriety.

In the first instance we should endeavour to evacuate the stomach; for which purpose a brisk emetic of sulphate of zinc, or tartarised antimony may be administered. Blood should also be taken from the jugular vein, or temporal artery; more especially if there appear a considerable determination of blood to the head. The head should be also washed with cold water, or some evaporating lotion.

For reasons which we have already explained, the patient should be carefully preserved in a warm atmosphere; and his body should be placed in an easy reclining posture, and be disencumbered of all tight bandages. These precautions are of the utmost moment, for many of those cases of inebriety which stand recorded in our journals, have terminated fatally, for want of attention to them.

ANIMAL POISONS.

This extensive kingdom of Nature presents us with a variety of objects destructive to human life; their agency, however, is on many occasions involved in impenetrable obscurity, and we are not even able to discover whether their deleterious effects depend upon certain definite principles, or upon the combination of circumstances connected with the individuals upon whom they act; and which thus render many substances *relatively* poisonous, that are innocuous to the general mass of mankind. With regard to the chemical laws by which animal compounds are governed, and the principles upon which their analysis may be conducted, the same observations will apply as those with which we introduced the consideration of vegetable poisons.

Cl. IV. SEPTIC POISONS.

The Bites of Venomous Animals.

Of the whole class of serpents, which according to *Linnæus* contains 132 species, *Plenck* assures us that only 24 are venomous. Of these, Europe has only 5, and England but 2; all of which are vipers, viz. *Coluber Aspis; C. Chersea; C. Prester (black viper*, peculiar to England); *C. Illyricus* (inhabits the mountains of Sclavonia); *C. Berus*, (the common viper of Germany, Spain, Italy, and England.)

The venom of the viper is contained in a bag situated on both sides of the head, beneath the muscle

of the superior jaw; it is secreted from the blood by a gland which lies just behind the orbit of the eye; from which a duct proceeds to the above-mentioned bag; in the upper jaw are situated two moveable teeth, very sharp towards the point, and hollowed nearly throughout their length. When the animal intends to bite, he presses the bag by means of the muscle, the venom comes out, arrives at the base of the tooth, passes through the sheath which envelopes it, and enters into its cavity by a hole which is found at this base; then it flows along the hollow of the tooth, and issues into the wound by the opening which is near its end, for the point itself is solid and sharp, in order that it may better penetrate the flesh of its victim. If these fangs be removed, or their structure destroyed, the viper is necessarily rendered harmless; whence *Galen* has observed that the mountebanks used to stop these perforations of the teeth with some kind of paste, whenever they suffered the vipers to bite them before spectators.

Symptoms occasioned by the Bite of a Viper.

Acute pain in the wounded part, attended with almost immediate tumefaction; the part appears first red, and then livid; the local affection extends itself, and the surrounding skin becomes similarly affected. The pulse is small, frequent, and irregular; the respiration is disturbed; the patient complains of great debility, and faintness which often amounts to syncope; vomiting takes place; pain is felt in the umbilical region, and he becomes jaundiced; and, in fatal cases, the wound assumes a malignant character, and gangrene takes place.

In this country the affection is rarely mortal, (*a*) although the circumstances of constitutional debility, unusual heat of season, and injudicious treatment, have in several instances led to a fatal issue.

Physiological action of the Poison of Vipers.

The result of numerous experiments justify us in referring this poison to the second division of our classification. The symptoms which it produces evidently depend on its absorption, and its passage into the circulation, when it exerts its peculiar action on the blood. It is somewhat singular that this poison should be perfectly inert when taken into the stomach; a fact, however, which appears to have been well known from the earliest periods; whence such wounds were commonly sucked (*b*) with impunity; and we learn that when *Cato* marched the remains of *Pompey's* army through Africa, he very wisely informed the soldiers, who, although dying from thirst, feared to drink the waters which contained serpents, that no evil could arise from such indulgence. (*c*)

> "Noxia Serpentum est admisto sanguine Pestis,
> Morsu Virus habent, et Fatum Dente minantur,
> Pocula Morte carent"——

Among the insects of Britain some will be found to possess fluids highly stimulant, and sometimes, although rarely, occasioning death. These British insects, however, cannot be compared in virulence with the *Furia Infernalis*, *Pulex Penetrans*, the *Scorpion*, and the *Tarantula;* but their natural his-

(*a*) Case of a woman bitten by a viper, *Med. and Phy. Journ.* vol. ii, p. 481.

(*b*) Celsus Medicin. lib. 5, c. 27.

(*c*) Lucan Pharsal, c. 9.

tory is nevertheless interesting, and the instances of mischief arising from an application of their venom are not unimportant. Of the genus *Vespa* we have three species, each of which possesses the property of producing violent and painful inflammation, sometimes followed by considerable danger, where the injury has been inflicted on parts of great sensibility, and in irritable habits, viz. Vespa *Crabro*, the *hornet;* V. *Vulgaris*, *common wasp;* C. *Coarctata*, *small wasp.* Instances are recorded of the wasp, having been introduced into the mouth with fruit, and produced by its sting on the *velum palati* a sudden swelling which has so intercepted the respiration as to occasion suffocation. (*a*) Of the *Apis* there are seven British species; the most remarkable of which are the Apis *Rufa*, or *small field bee;* A. *Mellifica*, *the common hive bee*; A. *Terrestris*, *humble bee;* and A. *Subterranea*, or *great humble bee.*

The sting of a single bee cannot be regarded as attended with danger, except in certain constitutions; but there are many instances of men and animals having suffered most terribly, and even fatally, by an attack of a swarm of these insects.

The supposed poison of the toad is a subject which we have already disposed of, under the literary history of poisons, *page* 139.

Putrescent Animal Matter.

A question has long since arisen, how far the ingestion of animal matter, in a state of putrefaction, is liable to affect the health? On the one hand it has

(*a*) See our remarks on the effects produced by the accidental ingestion of boiling water, page 317, and which will apply to the circumstances of the present case.

been maintained that the custom of eating game, venison, and other species of animal food, in a state of incipient putrescence, has never been attended with any inconvenience; but appears, on the contrary, to afford a repast of easier digestion, than the flesh of recently killed animals. On the other hand, it has been asserted by *Foderé*, (*a*) and corroborated by the testimony of others, that corrupted meat, fish, and eggs, are undoubted poisons; if, through inadvertence, necessity, or extreme hunger, they are taken in any quantity. The same distinguished writer relates that, during the siege of Mantua, several persons who were shut up in the town were seized with gangrene of the extremities, and scurvy, in consequence of having been driven to the alternative of eating the half putrid flesh of horses. In *Crantz's* history of Greenland we read an account of the death of thirty-two persons, at a missionary station, called Kangek, shortly after a repast upon the putrid brains of a Walrus.

It would appear that under circumstances not hitherto understood, certain parts of animal bodies become poisonous; and the *virus* would not seem to be connected with any stage of putrefaction, nor with any previous disease in the animal. As far as our limited experience upon this subject will allow us to generalize, the brain and the viscera would appear to be particularly susceptible of such a change. Some curious and highly interesting observations have lately been published by *Dr. Kerner*, of Wurtemberg, respecting the probable existence of a species of animal poison not hitherto known. He informs us that the smoked sausages, which constitute so

(*a*) Med. Legale, t. iv, 835.

favourite a repast to the inhabitants of Wurtemberg, often cause fatal poisoning. The effects of the poison occasionally manifest themselves in the spring, generally in the month of April, in a degree more or less alarming. He states that out of *seventy-six* persons, who became sick from having eaten such sausages, *thirty-seven* died in a short time, and that several others remained ill for years. Upon these occasions it has been observed, that the most virulent sausages were made of liver. *M. Cadet*, of Paris, analysed all the meats, examined all the vessels in which they had been prepared; and inspected the matters vomited, or found in the stomach after death, without being able to trace the vestige of any known poison; nor was there the slightest evidence in these cases of malevolence or negligence. Similar accidents have occurred at different periods in Paris; upon which occasions, the police officers visited the pig dealers, and were perfectly assured that the animals had never been fed with unwholesome food; the use of poison for rats, with which these places abound, was interdicted, and every precaution taken. What then, asks *M. Cadet*, is this poison found in sausage meats—is it Prussic acid—is it a new matter? It is evidently not the effect of putrefaction, since it exists in meats perfectly well preserved. To the above queries of *M. Cadet*, the author of the present work begs to add one more—may not the skin enclosing the sausage meat be the part in which the poison resides? It is well known that the bodies of animals who die of various diseases, are capable of communicating fatal diseases to the human species; and experience has shewn that such animal poison is particularly energetic in those parts that are commonly called the *offals*, in which term are included the

intestines; in the history of *fish-poison*, which will hereafter offer itself to our notice, we shall find numerous instances of dogs, cats, hogs, and birds, dying from eating these parts, while persons, who have partaken of the fish to which these *offals* belonged, remained uninjured. But to account for the deleterious change of which these parts appear to be occasionally susceptible, it does not appear necessary to suppose that the animal died in a state of disease. *Captain Scoresby*, in his "Account of the Arctic regions," states that although the flesh of the bear is both agreeable and wholesome, the liver of that animal is poisonous; sailors who had inadvertently eaten it, were almost always sick afterwards, and some actually died; while in others the cuticle has peeled off their bodies. The ancients appear to have entertained a fear with regard to the wholesomeness of the viscera of certain animals, and of the fluids which they secrete. *Pliny* says that the gall of a horse was accounted poison; and, therefore, at the sacrifices of horses in Rome, it was unlawful for the *Flamen* (priest) to touch it. *Mr. Brodie* has lately favoured the author with the communication of a fact, which goes far to support the theory we have offered with respect to the possible source of poison in sausages. He states that he has twice met with evidence of the acrid and poisonous nature of "*dog's meat*," as sold in the streets of London, which manifested itself by producing ulcerations, of a peculiar character, on the hands, and swelling in the axillæ, of the venders! May we venture to ask whether the prosecution of this inquiry might not possibly lead to some new and important conclusions respecting the origin of hydrophobia?

(*a*) Vol. 1, p. 519.

Where animals have died from disease, their flesh has undoubtedly produced affections by external contact, as well as by its ingestion. At the Somerset assizes in 1819, a case was tried, whose merits wholly turned upon the question now under discussion. A cow, having died of some disease, was thrown into the river Yeo, and several cattle that afterwards drank of the water died of a similar complaint. An action was accordingly brought against the owner of the cow for damages. The defendant, however, obtained a verdict, apparently from the evidence of a medical person, who asserted that animal matter in a state of putrefaction will not communicate contagion. But we must here beg to observe that this is quite another and distinct question; the merits of which we have already considered (*a*) The physiological question involved in the preceding case, is whether the carcase of an animal, whose fluids have been depraved by antecedent disease, is capable, or not, of producing morbid and fatal affections in the living animals with which it may come in contact? The facts collected by *MM. Enaux* and *Chaussier*, in their work entitled "*Methode de traiter les Morsures des Animaux enragés*," prove in a very satisfactory manner that the *Anthrax*, or *Malignant Pustule*, has for its cause a *septic virus* engendered in diseased animals, and transmitted to man. (*b*) The following are amongst the more striking examples cited from these authors by *Orfila*. "A shepherd bled one of his sheep, which had just died suddenly; he carried it home on his shoulders; but the blood penetrated his shirt, and was rubbed upon his loins. Two days after, a *malignant pustule* appeared upon this spot."

(*a*) See volume 1 of the present work, p. 95.

(*b*) See *Orfila*, vol. 2.

"A boy employed in skinning an ox which had been killed at an inn at *Gatinais*, because it had been sick, put the knife into his mouth. Shortly after which the tongue swelled; he experienced a tightness of the chest; the whole body was covered with pustules, and he died on the fourth day, in a state of general gangrene. The inn-keeper, who was pricked in the middle of the hand by a bone of the same animal, suffered great pain; gangrene seized the arm, and he expired on the seventh day. The servant girl received on her right cheek a few drops of the blood of the same ox, which produced inflammation, followed by gangrene."

In this country, a case has occurred highly illustrative of the present subject. A pupil of the veterinary college accidentally inoculated himself, during his dissection, with the matter of a *glandered* horse; the student soon experienced the usual symptoms of a septic poison; abscesses formed in various parts of his body, and he sank under the disease. Upon inoculating a healthy horse with some of the matter from the abscesses, the animal was attacked with the glanders.

This subject necessarily leads us to the notice of those effects which are frequently produced in the anatomist, by a puncture made during dissection. From the history of those cases which stand recorded, it does not appear that the poisonous effects are either connected with the putrefactive state of the body under dissection, or with the peculiar disease of which it died; but rather with the depraved state of the operator's health; for it has been repeatedly remarked that those students who enjoy high health universally escape the evil, however repeatedly they may have been exposed to its causes.

Poisonous Fishes.

The number and validity of recorded cases establish the fact, beyond dispute, that certain fish, especially the muscle, (*Mytilus Edulis*) and others of the shell tribe, have occasionally proved fatal to those who have eaten them; but it has been doubted whether such effects have arisen from a specific poison, or from the peculiar state of the stomach, (*a*) or idosyncrasy of constitution, in the persons affected. In other words, ought we to consider the fish, so circumstanced, as an *absolute* or *relative* poison? Each of these theories has met with its advocates, and many striking facts and illustrations have been adduced in their support. The weight of authority, however, as well as of argument, strongly inclines in favour of the existence of a specific virus, generated under circumstances which we are at present unable to appreciate. At the same time, it would be vain to deny, that certain fishes are more obnoxious to the stomach of one individual than to that of another; there are, for instance, those persons who are disordered whenever they eat a muscle; others who are incapable of taking an oyster without considerable disturbance of the digestive functions. This is obviously *Idiosyncrasy*, and must not be confounded with those cases where a number of persons have been simultaneously affected from a particular food, which, on all former occasions, had been eaten by the same individuals with perfect security. We must, therefore, at the very outset of our inquiry, admit the occasional

(*a*) See *Dr. Stone* on the Diseases of the Stomach, p. 80. We also beg to direct the attention of the medical reader to a paper entitled "On the effects of certain articles of food, especially oysters, on women after child-birth, by *John Clarke*, M. D." Med. Trans. vol. v, p. 109.

tion of these articles of diet as *relative* poisons; although it is evident to demonstration, that an *absolute* virus is generated in particular fishes, by the operation of causes hitherto unknown.

As a subject, highly important in its relations to maritime œconomy, the history of fish-poison constitutes an interesting branch of naval hygiene; instructions, therefore, for its investigation, ought always to be given to the naturalists and chemists who may be appointed to attend voyages of discovery. The notice of the scientific men who accompanied *Peyrouse* was officially directed to this important object; but the unhappy fate of that celebrated adventurer rendered the commission fruitless. The obscurity which attends this branch of toxicology has in many cases occasioned a corresponding degree of credulity; and sailors, as well as others, entertain an unfounded prejudice against various fish, that are not only innocuous, but even useful as articles of food. It would, however, appear that those which are harmless in one latitude may prove poisonous in another; it may be stated generally, that fish are more deleterious within the tropics, than in other seas. In torrid regions the softest kinds are the most susceptible of that change which renders them poisonous, and hence the policy of the Hebrew legislator becomes apparent; "*whatsoever has no fins nor scales in the waters, that shall be an abomination unto you.*" Levit. c. xi, v. 12, and Deut. cxiv, v. 9, 10.

The most complete history of this intricate subject, and of the dissertations to which it has given rise, is to be found in the *Edinburgh Medical and Surgical Journal*, (*a*) by *Dr. Chisholm*, who has brought toge-

(*a*) For October, 1808, vol. iv, p. 393.

ther, and cited a great number of authorities, biblical and classical, foreign and domestic, for its illustration. An interesting paper is also published on the same subject in the *Medical Repository*, (*a*) by *Dr. Burrows*. To the above sources we must beg to refer the reader who is desirous of farther information than can be afforded him by the present work.

Symptoms of Fish-poisoning.

Nausea; thirst; tormina of the bowels; vomiting; an eruption on the skin, resembling the nettle-rash; tumefaction of the face; head-ache; difficult respiration; distention of the abdomen; sometimes *cholera morbus;* vertigo; delirium; cold sweats; convulsions; death. Such is the train of symptoms, liable of course, to variation in the order of succession, which are produced by the ingestion of fish-poison, as occasionally existing in salmon, herrings, eels, mackarel, many of the testaceous and most of the crustaceous fish of this country; and in a great number of fish (*b*) inhabiting the tropical seas.

The species of fish, from which deleterious effects have more commonly arisen in this country, are the *Mytilus Edulis*, or muscle. *Dr. Burrows* has given us an account of two cases of death from eating these fish, which occurred at Gravesend, under the care of *Mr. Rogers*, surgeon of that place, upon whose

(*a*) For June, 1815, vol. 3, p. 445.

(*b*) *Dr. Burrows* has given us a list of them in the paper above alluded to; the most poisonous of which is the yellow-bill'd sprat, (*Clupea Thryssa.*) Indeed, says this author, it has rarely occurred that *immediate* death has ensued between the tropics from the virus of any other fish. *M. Orfila* observes that the action of this fish is so rapid, that it has been often seen at *St. Eustatia* that persons have expired while still eating it.

authority the statement is drawn up. (*a*) The subjects of the history were two youths of the ages of nine and fourteen, who had each eaten about a dozen of small muscles, which they had picked from the side of a fishing smack, in a dead and tainted state. In the *Gazette de Santé*, (*b*) and in the works of *Fodéré*, (*c*) and *Behren*, (*d*) similar cases are recorded. *Vancouver*, (*e*) in his voyage to the coast of America, relates that several of his men were ill from eating some muscles which they had collected and roasted for breakfast; in an hour after which they complained of numbness of the face and extremities, sickness, and giddiness. Three were more affected than the others, and one of them died.

Origin of Fish-poison.

If we admit that the symptoms which are occasionally produced by the ingestion of certain fish, depend upon the presence of poison, we have next to inquire into its nature and origin. *Dr. Burrows* considers that all the opinions which have been advanced upon this subject may, for the greater perspicuity and facility of discussion, be arranged under seven heads, viz. does the poison exist—1. *In the skin?*—2. *In the stomach and intestinal canal?*—3. *In the liver or gall bladder?*—4. *In the entire substance of the fish?*—5. *In the food of fishes?*—6. *Is it a morbid change in the system of the fish?*—7. *Is it a poison, sui generis?*

(*a*) Med. Rep. vol. 3, p. 445.

(*b*) Gazette de Santé, 1re Mars, 1812, p. 51.—Ibid. 21 Mars, 1813.—Ibid. 1, Octob. 1812.

(*c*) Tom. iv, p. 85.

(*d*) *Behren's* Dissert. de Affect. a comest Mytil.

(*e*) Voyage of Discovery, vol. 2, p. 286, 287.

Upon these several questions *Dr. Burrows* has offered some observations. There do not appear to be any facts which can induce us to consider that the poison resides only in the skin.

Experience has shewn that the *virus* is particularly energetic in the viscera, commonly called the *offals;* and yet there are no grounds for concluding that it exclusively belongs to these parts. *Captain Cook*, and *Messrs. Forster* were poisoned by eating a piece of the liver only of a species of *tetrodon;* yet they who ate of its substance were also poisoned.

An opinion has long prevailed that the poisonous principle is derived from the substances upon which the fish feeds; and that of muscles, in particular, from copper; this latter hypothesis has received the sanction of *Dr. Chisholm.* We however agree with *Dr. Burrows* in considering that it has neither the support of observation or analogy. *Dr. Beune* has supposed that the acrid principle is no other than the spawn of the *stella marina*, an insect which very commonly lodges in the muscle. It seems, however, more probable that it is a product of decomposition, but which requires the concurrence of certain circumstances for its developement.

Before we conclude the history of septic poisons, there appears to be a species of death, particularly noticed by *Dr. Gordon Smith*, (*a*) which merits our attention, as having some relation to this class of agents—the fact of persons having been "*eaten to death by maggots!*" Such a death has been assigned to *Sylla*, by *Plutarch;* and to *Antiochus Epiphanes*, by *Josephus*, and the writer of the book of Maccabees. The fate of *Herod* is ascertained by Scripture. In

(*a*) The Principles of Forensic Medicine, *page* 191.

modern history we have similar instances in *Charles* IX of France, and *Philip* II of Spain.

Numerous cases are recorded, in different medical works, (*a*) of the generation of maggots, *i. e.* the *larvæ* of different species of fly, not only in external sores and excoriations, but in the internal cavities of the human body. *Dr. Lempriere* (*b*) has related the case of an officer's lady, who had gone through an acute fever, but in whom these maggots were produced, which burrowed, and found their way by the nose through the *os cribriforme*, into the cavity of the cranium, and afterwards into the brain itself, to which she owed her death. But of all the cases of this kind, that related by *Dr. Gordon Smith* is of the most revolting kind. "In the month of July 1809, a man was found near Finglas, in Ireland, lying under the wall of a lime-kiln, at an early hour in the evening, with his face on the ground, apparently dead. On turning him on his back to ascertain the real state of the case, it was discovered that he was yet alive, but under the most appalling circumstances. On removing his coat, the whole surface of his body appeared to be a moving mass of worms. His face was considerably injured as if from a fall, or bruises; his eyes were dissolved, and their cavities, as well as those of the ears, nose, and mouth, were filled with a white living mass, from which such innumerable quantities of maggots were continually pouring out, that the skull seemed to be filled with nothing else. After some time he recovered strength enough to walk, and regained recollection and voice sufficient to tell who he was, where he lived, and how

(*a*) See Edinburgh Med. and Surg. Journal, for Jan. 1811, p. 41.—*Bateman* on Cutaneous Diseases, art. *Prurigo*.

(*b*) Observ. on the Diseases of the Army in Jamaica, vol. ii, p. 182.

he had been brought into that situation. It appeared that he was returning home upon a car the evening before; having drank to excess, he fell off, and remained in a state of insensibility until he was discovered. He could neither account for the wounds in his head, nor for his being so far from the road; but it appeared probable that he had received the contusion from the fall, and had insensibly crawled to the place where he lay. It was conjectured that the state of the atmosphere, as to humidity and temperature, had brought on a solution of the solids in the bruised parts, already disposed to putrescency, and now in close contact with the moist earth. In these, the eggs of innumerable insects being deposited, their generation proceeded with rapidity under circumstances so favourable. Every attention was paid to the unfortunate individual; he was removed to shelter, the parts were washed with spirits and vinegar, and the loathsome objects removed, as far as was possible. Cordials were poured down his throat, but he swallowed with difficulty; and in a very short time spasms took place which prevented him from swallowing altogether. The putrescence advanced; in a short time he became insensible; and about noon the following day he died, in a state of total *putrisolution*."

AERIAL POISONS.

Under this division we include all those deleterious substances which can be administered through the medium of the atmosphere.

Those gases, the respiration of which occasions death by the negative operation of excluding oxygen, are not ranked under the class of poisons, for the history of such bodies involves physiological views peculiar to themselves, and belongs more correctly to the subject of suffocation, under which head it has already met with full consideration, *vol.* 2, *p.* 48.

Aërial poisons are of very undefined extent, and their history is involved in considerable obscurity. Every poison, capable of volatilization, may be admitted into the division; and even those substances which are generally regarded as fixed, may be mechanically suspended in the air, and thus produce their effects on the living system, through the medium of the lungs, stomach, or nerves. In the present state of our knowledge, we have, perhaps, only an imperfect idea of the distinction between a fixed and a volatile body. A very interesting paper on this subject was read before the Royal Academy of Berlin, by *Professor Hermbstaed*, (*a*) in which he observes that, generally speaking, we might consider all bodies as volatile, as it is most probable that, could we produce a sufficient degree of heat, no substance could resist it. The professor also states that many bodies, hitherto considered as fixed, are actually volatilized at the temperature of boiling water; such he found to be *lime*, *baryta*, *strontia*, and *potass*. We apprehend, however, that the professor has, in these instances,

(*a*) Giornale di Fisica, &c. Secondo Bimestre, 1817.

mistaken a phenomenon for *volatility*, which it is highly important to distinguish from it, viz. *the elevation of a certain portion of a fixed body, by the carrying power of a vapour;* thus, fixed oil may, in a minute proportion, be carried up with the steam of water. Certain bodies, however, which have been long considered as perfectly fixed at the ordinary temperature of the atmosphere, have been lately discovered to undergo a slow and almost imperceptible evaporation under such circumstances; and the discovery has led to a very satisfactory solution of several problems which were previously unintelligible. We shall adduce a striking exemplification of this truth, under the consideration of mercurial vapours.

The substances, included under the head of *Aërial poisons*, may be conveniently arranged in two orders, viz.

I. Those, whose particles exist mechanically suspended in the atmosphere.

II. Those, which are presented to us in a *vaporous* or *gaseous* form.

Of the first division the various arts will furnish ample illustration, as for instance the occupations of the colour-maker, plasterer, cotton-spinner, dry-grinder, (*a*) stone-cutter, hatter, furrier, miller, &c. &c. In all of which a subtle matter is given off,

(*a*) There is no trade more immediately destructive of health than dry grinding steel; the workmen are usually attacked by what is called the grinder's asthma at twenty-five or thirty years of age, and few of them live to forty. The Society of Arts have long offered a reward for the invention of some mode of securing the workmen from this dreadful calamity, and in 1822 awarded their gold medal to *Mr. J. H. Abraham*, of Sheffield, for his Magnetic Guard for Needle-pointers, (see Transactions for 1822.) The contrivance is likely to answer its intended purpose, provided the obstinacy and prejudice of the workmen can be overcome by the perseverance of the master manufacturers, who are morally bound to adopt every probable means of securing the health of those employed under them, even though their servants should themselves neglect it.

which becoming mechanically suspended in the air, penetrates the structure of the pulmonary organs, and excites disease, and even death. (*a*) In illustration of the second division, we have the trades of water-gilders, acid manufacturers, night-men, bleachers, and various others, many of which have been already noticed under the medical and chemical consideration of nuisances, *vol.* I, *p.* 330.

In the present chapter we cannot attempt an enumeration of every substance which may act as an aërial poison; we shall confine our attention to the history of a few bodies which are calculated to afford general elucidation, and are likely to become objects of forensic interest.

Mercurial Vapours.

It is not the least interesting fact in the history of aërial poisons, that substances, which are found to be extremely slow in their action, or even quite inert, when administered in their solid or liquid state, exert a very rapid and energetic operation when they are presented to the human body in the attenuated form of vapour. This fact is well illustrated by the subtlety and activity of metallic mercury *in the state of vapour;* a substance which, according to the highest authorities, is quite inactive when introduced in its grosser form into the stomach. It is thus that the workmen employed in gilding, silvering looking-glasses, constructing barometers, &c. experience such dreadful effects; that such effects arise from the *metal* in a state of vapour, and not, as some have supposed, from the *oxide*, (*b*) is a fact capable of demonstration, for

(*a*) *Diemerbroeck*, lib. ii, p. 443.

(*b*) The oxide of mercury is not volatile.

the artists at Birmingham affix an apparatus in their chimneys as a system of economy, in order to collect the mercury, which is always found in its *metallic* state. (*a*) From the late interesting experiments of *Mr. Faraday*, (*b*) it appears that *mercury* rises in vapour at the ordinary temperature of the atmosphere; the knowledge of which fact will afford a very satisfactory explanation of several phenomena, which were previously unintelligible. *Dr. Hermbstaed*, in the memoir, above mentioned, "on the volatility of substances hitherto considered as fixed bodies," relates the following curious fact with regard to the volatility of mercury. "At the Royal Manufactory of looking-glasses in Berlin, during a severe winter, the artificers who worked in a room, which had originally served for the process of *silvering* the glasses, lighted a fire, and thus heated the apartment to between 86° and 96° *Fah.* In a few days the whole of them were, to their great surprise, affected by a strong sa-

(*a*) Where mercury is sublimed, it will usually assume the appearance of a black powder, in consequence of the extreme state of division it has undergone. This appearance has no doubt deceived the superficial observer, and given origin to many erroneous statements.

(*b*) "A small portion of mercury was put through a funnel into a clean dry bottle, capable of holding about six ounces, and formed a stratum at the bottom not one-eighth of an inch in thickness; particular care was taken that none of the mercury should adhere to the upper part of the inside of the bottle. A small piece of leaf-gold was then attached to the under part of the stopper of the bottle, so that when the stopper was put into its place, the leaf-gold was enclosed in the bottle. It was then set aside in a safe place, which happened to be both dark and cool, and left for between six weeks and two months. At the end of that time it was examined, and the leaf-gold was found whitened by a quantity of mercury, though every part of the bottle and mercury remained, apparently, just as before. This experiment has been repeated several times, and always with success. The utmost care was taken that mercury should not get to the gold, except by passing through the atmosphere of the bottle. I think therefore it proves that at common temperatures, and even when the air is present, mercury is always surrounded by an atmosphere of the same substance.—*On the vapour of mercury at common temperatures, by M. Faraday, Chemical Assistant at the Royal Institution.* Journal of Science and the Arts, vol. 10, p. 354.

livation, as there was no trace of mercury in, or near the room. They consulted on the subject, and suspecting the real cause of the event, had the flooring of the room taken up, when about 40 lbs of the metal were found spread about in different parts, where it had fallen at various times during the operation of silvering, which had been executed in that room before." With such facts before us, we shall no longer be unable to explain the effects which were produced on board his majesty's ship *Triumph*, off Cadiz, in April 1809, by the bursting of leathern bags containing quicksilver, and the consequent dispersion of not less than three tons of the metal through the vessel. The interest excited by this case has been very great, and as the facts, involved in its history, are of high medical importance, we were induced to apply for permission to search the journals of the ship; and, through the kindness of *Dr. Burnett*, one of his majesty's commissioners for victualling the navy, and the assistance of *Mr. Plowman*, who held the situation of surgeon to the *Triumph*, we have been enabled to obtain a correct and detailed history of the event. Previous to the circumstances we are about to describe, "the ship's company had been tolerably healthy, when unfortunately a quantity of quicksilver was received on board, and diffused over the ship in consequence of the bursting of the leathern bags, in which it had been enclosed; when its effects were soon displayed upon the crew, by occasioning ptyalism, partial paralysis, affections of the bowels; so that in three weeks, no less than two hundred men were in a state of salivation. In consequence of which two transports were taken up as hospital ships, in which the slighter cases soon recovered; but as many fresh cases occurred daily, *Vice-Admiral Pickmore*

ordered a survey on the ship, and ship's company, by the surgeons of the squadron, on the third of May, who reported the necessity of sending the ship into port, in order to clear her hold, change part of her provisions, into which the quicksilver had insinuated itself, and to purify her by means of ablution. This was accordingly done; but on stowing the hold afresh, every man so employed, as well as those engaged in the steward's room, were attacked with ptyalism. Fresh cases happened daily, until they took their departure from Cadiz on the 13th of June; after which but few occurred, which was attributed by the surgeon to the coldness of the weather, the fresh breezes from the north-east, from the men having been kept constantly on deck, and not allowed to sleep on the orlop, and from not suffering those affected with ptyalism to lie on the lower deck; as well as from the constant attention paid in the ventilation of the ship by means of wind-sails. But, notwithstanding all these precautions, the ship had not been more than ten days at sea, when many of the men became worse, and it was found necessary to send twenty-four seamen on board the *Goshawk*, and two transports. On the arrival of the *Triumph* in Cawsand Bay, on the 5th of July, there did not remain one case of ptyalism on their list. During this extraordinary visitation two men died from excessive ptyalism, one of them at Cadiz, having previously lost his teeth, and both cheeks at the time of his decease being in a state of sphacelation; the other, who died at Gibraltar, had lost the whole of his teeth, two-thirds of his tongue, and, at the time of his death, the lower lip was in a state of gangrene. To the interesting facts above related, *Mr. Plowman* adds, that the interior of the ship was co-

vered with a black powder, and that the copper bolts displayed the mercurial influence. The mercurial vapours proved fatal to the living stock on board, for nearly all the poultry, sheep, pigs, mice, (*a*) goats, cats, a dog, and even a canary bird, died from its influence.

Sulphuretted Hydrogen Gas.

This gas is transparent and colourless; it has the property of inflammability, and when set on fire in the open air, burns with a bluish flame, and deposits a certain portion of sulphur. It is distinguished by an excessively fœtid smell, which has been aptly compared to that of rotten eggs. Its habitudes with other gases are interesting and important; by admixture with *chlorine*, it immediately undergoes decomposition, yielding its hydrogen, so as to form *hydrochloric acid (muriatic acid)*, and consequently depositing its sulphur; with *ammoniacal gas* it combines, and forms an *hydro-sulphuret of ammonia*; when mingled with *sulphurous acid gas*, the hydrogen of the former combines with the oxygen of the latter, and the sulphur of both is precipitated; when passed over ignited charcoal it is converted into carburetted hydrogen gas, and sulphur is deposited.

It is soluble in water, and the solution precipitates the different metals from their saline solutions, in the

(*a*) *Mr. Plowman* has since stated, in conversation, that he has seen five or six mice, in one day, come into the ward-room, leap up a considerable height, and fall down dead on the deck. He also stated that the food for the use of the canary bird was kept in well closed bottles, so that it was impossible for it to have contracted any metallic impregnation.

form of sulphurets; a property which at once distinguishes this gas from every other.

It has been long considered a very energetic poison, and it would, at the same time, appear to be a very insidious one; for sensibility is quickly destroyed by it, without any previous suffering. We are acquainted with a chemist who was suddenly deprived of sense, as he stood over a pneumatic trough, in which he was collecting the gas. It would seem to act upon the nervous system through the medium of the blood, in which it is extremely soluble. It constitutes the particular gas of privies, and is the immediate cause of those accidents which we have already described in a former part of this work, *vol.* 1, *page* 100; since the printing of which we have heard of the death of four persons from emptying a privy at Brompton. This gas will be sometimes developed during the imperfect combustion of wet coals (*a*); and it was probably owing to its presence, or to that of *carburetted hydrogen*, that the accident arose which is recorded by *Mr. Sutleffe* in the *Medical Repository*. "He was hastily summoned to a neighbouring family at bed-time, where he found a female domestic labouring under a shrill, laborious inspiration; she had taken up from a good kitchen fire, a panful of live coals, from which a sudden suffocating blast seized her."

(*a*) The gases given off by burning coal, will vary very much according to the activity of the combustion, and the degree of moisture present; so that we may expect to receive sulphuretted hydrogen, sulphurous acid, carbonic oxide, carbonic acid, and carburetted hydrogen.

Carburetted Hydrogen Gas.

This gas is developed by several chemical processes. We have just stated that if, during the burning of charcoal, moisture be present, it is evolved in abundance. It appears to be particularly fatal to animal life. *Dr. Beddoes* made many experiments upon the subject, from which it would seem to destroy life by rendering the muscular fibre inirritable without producing any previous excitement. In order to decide this question, *Sir Humphry Davy* (*a*) ventured to take three inspirations of the gas produced from the decomposition of water by charcoal. "The first inspiration produced a sort of numbness and loss of feeling in the chest, and about the pectoral muscles; after the second," says he, "I lost all power of perceiving external things, and had no distinct sensation, except a terrible oppression on the chest; during the third expiration, this feeling disappeared; I seemed sinking into annihilation, and had just power enough to drop the mouth-piece from my unclosed lips. There is every reason to believe, that if I had taken four or five inspirations, instead of three, they would have destroyed life immediately, without producing any painful sensation."

Chlorine—*Oxy-muriatic Acid Gas.*

This gas, which is now considered as an elementary body, has received from *Sir Humphry Davy* the name of *chlorine*, from the green colour which cha-

(*a*) Researches Chemical and Philosophical, chiefly concerning nitrous oxide, &c. London, 1800.

racterises it. Its odour is so penetrating and insupportable that it is impossible to respire it, even when considerably diluted with atmospheric air, and yet it will support combustion. It discharges vegetable colours, whence it forms the basis of various bleaching preparations. According to the experiments (*a*) of *M. Nysten*, this gas is not absorbed when respired pure, but appears to act only by irritating the bronchiæ locally; and so energetic is its action, that the animal dies before there is sufficient time for asphyxia to take place from the circulation of black blood. When it is respired in a dilute form, it produces a severe cough, and, according to *Fourcroy*, it occasions a phlegmonic inflammation of the bronchial membranes. The death of the ingenious and indefatigable *Pelletier* was occasioned by his accidentally inhaling a proportion of this gas; a consumption was the consequence, which in a short time proved fatal. In the *London Medical and Physical Journal for November*, 1821, a case of a person is recorded who was poisoned by bleaching liquor.

Sulphurous Acid Gas.

The gas is generated by the combustion of sulphur. It is colourless; has a pungent smell, resembling that of burning sulphur, and is very soluble in water. It would appear to destroy life by a peculiar action on the blood.

(*a*) Recherches de Physiologie et de chimie, p. 144, an. 1811.

OF HOMICIDE BY MISADVENTURE OR ACCIDENT.

If a physician gives a person a potion without any intent of doing him any bodily hurt, but with an intent to cure or prevent a disease, and contrary to the expectation of the physician it kills him, this is no (culpable) homicide, and the like of a chirurgeon; 1 *Hale, P. C.* 429; 4 *Bl. Comm.* 197. But query if he were not a regular physician or surgeon? on this there appears to be some difference of opinion; it was anciently holden that if one, that is not of the mystery of a physician or surgeon, take upon him the cure of a man, and he dieth of the potion or medicine, this is covert felony. *Si un que nest physition ou surgeon emprent sur luy un cure, que murrust in sa main, que cest felonie; Stanford's Pleas of the Crown, cap.* 9; *Fitzherbert, tit. coron. p.* 311; *Briton, fol.* 14; *Lambard, Eiren. tit. Felonie* saith thus; that *Thorpe*, 43 *Ed.* 3, 33, saith he knew one to be indicted accordingly. *Dalton, p.* 470, queries this case, as it is difficult to determine the actual cause of death, and there appeareth no will to do harm, but rather to do good, and "the 34 *Hen.* 8, *c.* 8, leaveth so great a liberty of such practice to unskilful persons, that it will be hard now to make it felony." Now the statute of *Henry the eighth* applies only to the cure of certain diseases or sores, particularly specified, and others like to the same, by external appli-

cations, and to drinks for the stone, strangury, or agues, provided (if the preamble may be relied on) "the said persons have not taken any thing for their pains or cunning, but have ministered the same to the poor people only, for neighbourhood, and God's sake, and of pity, and charity;" in such sense the act is reasonable even to this day, much more then, when from the scarcity of regular practitioners, the charitable in the country were frequently called upon to administer on emergencies, where no medical aid could be procured; but surely this act can never have been intended to warrant the administration of dangerous medicines, arsenic, corrosive sublimate, or cantharides, such indeed as may be fairly classed as absolute poisons, except when in skilful hands, nor the performance of surgical operations. *Dalton* indeed adds "But if a smith or other person (having skill "only in dressing or curing the diseases of horses or "other cattle) shall take upon him the cutting, or "letting blood, or such like cure of a man, who "dieth thereof, this seemeth to be felony; for the "rule is, *quod quisque norit, in hoc se (non) exerceat.*" And if it were otherwise, great evils might arise; for persons intending to commit murders, need only cover their design by a pretence of administering medicine; (*a*) thus in *Vaux's* case, the professed purpose of administering the cantharides, was not illegal, yet the prisoner was found guilty of murder. In *Donellan's* case, what would a plea have availed, that the chemical principle of laurel water was, in the prisoner's opinion, a cure for consumption, with which *Sir*

(*a*) See the case in *Valentini*, *P. M. L.* p. 538, of a woman wilfully killed by continual and excessive doses of sulphuric acid, administered to her under pretence of medicine.

Theodosius Boughton was threatened, and that it had been administered to cure, and not to kill him; or on the death of *Mr. Scawen*, (*b*) that his mistress had infused or dissolved corrosive sublimate in all his drinks and medicines, to cure him of an ulcer, with which he was afflicted; and that she had done it secretly, because he had an avowed aversion to mercurial medicines. Yet such pleas would continually be made, if the doctrine of allowing all persons however ignorant and unqualified to tamper with medicines, should be admitted. On the other hand there is very considerable weight of authority; *Sir. Wm. Blackstone* follows *Sir Mathew Hale* in his opinion, that this doctrine, that if any die under the hand of an unlicenced physician it is felony, is apocryphal, and fitted to gratify and flatter doctors and licentiates in physic; though it may have its use to make people cautious, and wary, how they take upon themselves too much in this dangerous employment; 1 *Hales, P. C.* 429, 430; 4 *Bl. Com. c.* 14, *p.* 197; it is difficult to imagine how caution is to be enforced by taking away the liability to punishment. Mr. Serjeant *Hawkins* takes a different ground; "Also it hath "been anciently holden, that if a person, not duly "authorised to be a physician or surgeon, undertake "a cure and the patient die under his hand, he is "guilty of felony;" but inasmuch as the books wherein this opinion is holden (*Stamford, P. C.* 16; *Pulton*, 22; *Crom.* 27; 43 *Ed.* 3, 33; *Fitz H. Cor.* 163; *Britt. c.* 5; and 4 *Inst.* 251) were written before the statutes of 23 *Hen.* 8, which first excluded

(*a*) See the trial of *Jane Butterfield* for the murder of *Wm. Scawen*, Esq. published from the short hand writer's notes, London 1775. *Miss Butterfield* was acquitted, the case is therefore put suppositiously.

such felonious killing, as may be called wilful murder of malice prepense, from the benefit of clergy, it may be well questioned whether such killing shall be said to be of malice prepense within the intent of that statute; however it is certainly highly rash and presumptuous for unskilful persons to undertake matters of this nature; "*and indeed the law cannot be too se-* "*vere in this case,* in order to deter ignorant people "from endeavouring *to get a livelihood* by such prac- "tice, which cannot be followed without the mani- "fest hazard of the lives of those who have to do "with them;" 1 *Hawk. P. C.* 131. This doctrine does not by any means go as far as *Sir Mathew Hale;* for as the supposed alteration of the law is referred to the operation of the statute, which takes away the benefit of clergy from murders, that is to say from felonious killing with malice prepense, it does not apply to manslaughter, to which the benefit of clergy was still allowed. But there yet remains a question, whether in the case of a person illegally taking upon himself the administration of dangerous medicines, for profit, (and it must be observed that the greater number of nostrums are, from the powerful nature of their ingredients, highly dangerous) does not subject himself to a charge of murder if any die under his hands; for "if a man does such an act, of "which the probable consequence may be, and "eventually is, death, such killing may be murder, "although no stroke is struck;" 4 *Bl. Com.* 197. What then if a man for profit administer dangerous preparations of mercury to persons necessarily exposed to change of temperature, and inclemency of weather; nay, delusively hold out to them, that no mercury is employed, by which they are induced to neglect the most ordinary precautions; if death ensue

is not this equally murder, *in foro conscientiæ*, as killing with the sword? Malice may be implied in law, as well as apparent; it may be general, as well as particular; and whenever a man has evinced, whether from avarice, cruelty, or wantonness, such disregard for the lives and safeties of mankind, as warrants the imputation of general malice, it is not necessary that individual malice be proved towards the party who has become his victim. (*a*) 1 *Easts. P. C.* 231. "So too if a man hath a beast that is used to "do mischief, and he knowing it, suffers it to go "abroad, and it kills a man, even this is manslaughter in the owner: but if he had purposely *turned it* "*loose*, though barely to frighten people, and make "what is called sport, it is with us (as in the Jewish "law) as much murder as if he had incited a bear or "dog to worry them;" 4 *Bl. Com.* 197. And *Hale* says, 1 *P. C.* 431, I have heard that the owner was hanged for it. Is there much difference, whether the mischief be done by a dangerous beast, or a poisonous drug? to us it appears that the man who vends or administers the one, is as guilty as he who is convicted of turning out the other. If *A* give purging comfits to *B* to make sport and not to hurt him, and *B* dies thereof, it is a killing by *A*, but not murder, but manslaughter; 1, *H. P. C.* 431; *Dalt. cap.* 93. Here *A* is not supposed cognisant of the dangerous nature of the comfits,

(*a*) Such was the case of the ignorant man who went out at night with the intention of shooting a ghost, which was supposed to haunt the village of Hammersmith; he actually shot a bricklayer's labourer who was returning from his work; this was held to be murder, and the prisoner was convicted; he was not indeed a fit subject for execution, and was therefore pardoned; but this should not be extended into a doctrine, that gross ignorance, producing death, is always a pardonable offence.

With every deference therefore to the very high authorities, which have supported a contrary opinion, we cannot but conclude, that the unlawful administration of medicine for profit, by which death ensues, may constitute wilful murder in some cases, manslaughter in most, and a high misdemeanor in all, according to the quantity of general malice, ignorance, and presumption, evidenced in each case; under what class each individual instance may fall, is a proper subject for a jury. If the law be defective on this point it cannot be too soon amended, and we must express our sanguine hope, that the consideration of revenue, as arising from the stamp duties on patent medicines, will not be allowed to influence the legislature in a matter vitally important to the public health, and to the lives of his majesty's subjects, more especially as the evil principally operates on the class, whose personal vigour constitutes the strength and sinews of the country. And yet in candour we must admit the difficulties and embarrassments with which the subject is beset: the multiplication of restraints in a free country is very naturally regarded with extreme jealousy, and however anxiously we may desire to crush those harpies of society, who scatter poison and death around, under the pretence of affording relief, yet the object must not be purchased by the infringement of civil liberty.

Doctor *Goodall*, in his historical account of the college's proceedings against empiricks, published in 1684, mentions many cases in which death has ensued from unlawful administration of medicine; in some of these cases, the college punished the offenders according to their jurisdiction; some by fine and imprisonment, for mala praxis; others they sued at law, for the penalty of five pounds per month for un-

licensed practice. But in those instances which appeared to require greater severity of punishment, they consigned the accused to the ordinary course of justice. See *Humphrey Beven's* case, *Goodall's Pro.* 425—*John Hope's* case, for giving two apples of coloquintida to a man as a purge, of which he died. *Ibid.* 441.

END OF VOL. II.

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